South Coast Baseline Program Final Report: Kelp and Shallow Rock Ecosystems

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Baseline Characterization of the Shallow Rocky Reef and Kelp Forest Ecosystems of the South Coast Study Region

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List of Acronyms Used in the Report

CCSR - Central Coast Study Region
CDFW - California Department of Fish and Wildlife
CPFV - commercial passenger fishing vessel
CRANE - Cooperative Research and Assessment of Nearshore Ecosystems
ENSO - El Nino/Southern Oscillation
MLPA - Marine Life Protection Act
MPA - Marine Protected Area
NCC - North Central Coast Baseline program
NCI - Northern Channel Islands
PDO - Pacific Decadal Oscillation
PISCO - Partnership for Interdisciplinary Studies of Coastal Oceans
POTW - publicly owned treatment works
SCSR - South Coast Study Region
SCCWRP - Southern California Coastal Water Research Project
SST - sea surface temperature
UPC - uniform point contact
VRG - Vantuna Research Group
WQI - Water Quality Index
YOY - young-of-the year

Executive Summary

Kelp and shallow rock ecosystems are iconic features along the coast of California with services that span commercial and recreational consumptive uses and a diverse array of non-consumptive services (e.g., tourism, diminishing coastal erosion). Kelp forests are among the most productive ecosystems on Earth. Kelp beds and rocky reefs provide food, shelter, and habitat for a rich diversity of ecologically and economically important species, while drift kelp and dissolved organic matter from kelp provide an energetic resource to populations of species both within and around kelp beds. In southern California, kelp beds and rocky reefs support valuable commercial and recreational fisheries that target a diversity of fishes and invertebrates. For example, the Red Urchin fishery is one of the highest value fisheries in California, with about two-thirds of all landings caught within the Northern Channel Islands (NCI).

Our approach to creating a baseline characterization of kelp and shallow rock ecosystems in the Marine Life Protection Act (MLPA) South Coast Study Region (SCSR) involved (1) new surveys of targeted elements of kelp forest and rocky reef ecosystems using SCUBA and (2) analyses of existing historical datasets on rocky reef ecosystems. To characterize kelp forests inside and outside of the recently established Marine Protected Areas (MPAs) of the Southern California Bight, we used visual SCUBA surveys to assess habitat characteristics of the rocky substrate and the major players in the kelp forest community, including fishes, mobile and sessile invertebrates, and algae. Depending on the morphology and lifestyle of each species, abundance was estimated using swath surveys that count individuals within a defined area, or uniform point contact surveys that estimate the percent cover of colonial invertebrates and other species for which distinguishing individuals is challenging.

The kelp forest surveys conducted for this project are designed to detect variations in the kelp forest ecosystem across space and through time, including establishing a baseline for detecting future effects of MPAs on these communities. MPAs around the world have been shown to increase both the size and abundance of fished species within their borders, but these effects take time, as organisms protected within MPAs must grow and reproduce for these changes to be apparent. The baseline study described in this report was conducted the year before and the year following MPA implementation, which is not long enough for most species to respond to MPAs, thus we focus the majority of our baseline results on the spatial variation in kelp forest communities in the region, with assessments of year to year differences mainly serving as an estimate of the natural temporal variability. These baseline surveys allow us to understand the initial condition of the kelp forest communities inside and outside of MPAs at the time of MPA implementation and will provide a valuable reference point for interpreting any changes to these communities in the future. However, unlike other regions of the MLPA, the SCSR benefits from a large amount of previous work in rocky reef habitats including monitoring conducted by the two primary programs conducting this baseline survey (Partnership for Interdisciplinary Studies of Coastal Oceans – PISCO and Vantuna Research Group – VRG). As such, we include those data to the extent possible in order to assess changes over time, including changes in older MPAs in the NCI.

The scope of what is being presented in this report is unprecedented for a habitat in a single study region associated with the MLPA and its implementation in California. The SCSR consists of as much coastline (1197.2 km) as the rest of the state. In addition, this spatial challenge extends to the number of MPAs: 41 of 50 MPAs in the SCSR have rocky reefs and this is nearly half of the MPAs in California (N = 109 excluding the 15 special closures across the state). We do not report any salient data gaps. On the contrary, we have developed and implemented a program that can study any and all of the shallow reefs in the Southern California Bight. Moving beyond the extensive and intensive biological and physical sampling; this program extended far beyond simply establishing a monitoring program by leveraging substantial regional partnerships to integrate the broader goals of the MLPA in an understanding of novel bight-wide processes (e.g., fishing and pollution). We incorporate the metrics and 'lessons learned' from our collaborators and colleagues, and then establish a novel direction couched within the intricacies of the SCSR. Our program has been developed over decades and features the 15-year PISCO/VRG collaboration that is continually pushing the study of nearshore rocky reefs and kelp beds to the forefront of scientific inquiry. This work presented here not only details the current status of the nearshore rocky reefs in the Southern California Bight but also, and more importantly, sets the stage for establishing the tools necessary for increasing the health of the nearshore rocky reef ecosystem of the SCSR.

We systematically surveyed 94 of the 122 nearshore rocky reefs in the SCSR. This synoptic baseline survey was conducted at 75 individual sites in 2011 and 88 sites in 2012. In addition, we incorporate two similar 'historical' data sets from 59 sites in 2004 and 79 sites in 2008. From 2011-2012, we surveyed all accessible nearshore rocky reefs found in the SCSR MPAs and determined the appropriateness of references areas for each.

This baseline provides, for the first time, a taxonomically exhaustive biogeographic assessment of the nearshore subtidal reefs in the SCSR, improving significantly on our knowledge of the region and incorporating newly established and existing MPAs. Results confirm previously described patterns for subtidal fishes, reflect the physical oceanographic complexities of the Southern California Bight and add new knowledge to biogeographic patterns of algae and invertebrates. The SCSR is characterized by strong environmental gradients, a major defining feature of the SCSR compared to the other California MLPA Study Regions that have relatively more spatially consistent physical environments. These differences are reflected biologically in a high degree of kelp forest community structure across the region. We identified 17 geographically cohesive community clusters, each with distinct fish, invertebrate, and algal assemblages (Figure ES.1). Although kelp forest communities in the SCSR are highly variable, the structure can be related to the sea surface temperature patterns caused by the confluence of the California Current, the Southern California Counter Current and localized upwelling. Benthic habitat structure also varies within the region; the geology and structure of island reefs are functionally different from mainland reefs. Mainland reefs generally are less steep, can be found significantly offshore of the coastline, and have a greater influence of sedimentation moving through the system. With few exceptions, island reefs are generally abrupt, high relief structures, tightly fit to the coastline with less influence of the nearby soft bottom habitat. Ideally, long-term monitoring of MPAs should be distributed across the distinct areas as each is likely to respond differently.

We took advantage of a set of older MPAs (implemented in 2003 and monitored since 2000) in the NCI. In that region and over this longer time frame since MPA implementation, we found higher levels of fish biomass inside the MPAs compared to outside control areas for fish species targeted by fishing. There are no consistent MPA effects for the wider diversity of unfished species (Figure ES.2). Importantly, the pattern of higher biomass inside MPAs that was presented at the five-year review of those MPAs, has been maintained and is even stronger after 10 years. Another important finding from the NCI MPAs is that there was an increase in biomass *outside* of the MPAs as well for both fished and unfished species. Optimistically viewed, this should begin to alleviate the concern that concentrating fishing outside of the MPAs would negatively impact the open areas. We also determined that due to the complexities of this system, annual monitoring was an appropriate scale for illuminating these patterns.

With few exceptions, we identified and sampled appropriate reference areas for all the MPAs in the SCSR. The baseline surveys show that individual MPAs and their adjacent reference sites are generally well-matched and contained very similar communities and habitat at the time of MPA implementation. Establishment of these reference areas is critical to disentangling changes due to the effects of protection from changes due to environmental variability. If differences between MPA and associated reference sites develop in the future, these differences may be attributable to MPA effects. In addition, future monitoring efforts can take advantage of the time series at these sites, which, in some cases dates back to surveys in 2004.

Considering the anthropogenic stress of having one of the largest coastal population centers in the continental United States, it was critical that we began tackling the role of potential point source pollution on the health of these nearshore resources. We coordinated with the Southern California Coastal Water Research Project (SCCWRP) to develop the first data layers of major point source pollution [large rivers and publicly owned treatment works (POTWs)] for the region. These potential stressors vary spatially, not unexpectedly, with the population centers. Unfortunately they also correspond to areas of the greatest fishing pressure.

Fishing pressure varied spatially throughout the Bight and by industry and taxa. We present, for the first time, extraction rates by taxa and by industry (commercial vs. recreational fisheries) for all areas in the SCSR that contain shallow (< 30 m depth) rocky reef habitat. The commercial harvest in this region consists primarily of invertebrates and preferentially targets the offshore island reefs. Recreational CPFVs fishers focus more on mainland coastal reefs closer to ports and primarily extract finfish. In future analyses of the impacts of MPAs, these data may provide explanatory power with respect to spatial differences in the magnitude and rates of change across different MPAs. Greater effects would be expected for species that are more heavily exploited in the local area of a given MPA.

One objective of the baseline program was to assess candidate system indicators and examine potential new candidates. Ecological indicators are becoming mainstream tools for assessing impacts of human disturbance and general environmental 'quality' and can serve to condense complex information into simple metrics. In this study, we attempted a quantitative evaluation of the biological indicators identified in the MLPA South Coast Monitoring Plan according to several criteria common to 'indicators' in general. We were successful in identifying several potential fish [e.g., Kelp Bass (*Paralabrax clathratus*), California Sheephead (*Semicossyphus pulcher*)] and invertebrate [e.g., Red Urchin (*Strongylocentrotus franciscanus*)] indicator species for the SCSR, but conclude that due to the high levels of geographic variation across the SCSR, most species would not be suitable indicators for use across the entire region. However, our analysis utilizes quantitative metrics based on only several years of monitoring data and other considerations for ecosystem indicators surely will play important roles.

In conclusion, the SCSR baseline rocky reef program established an unprecedented, taxonomically rich, spatially extensive survey upon which future monitoring can be based. Appropriate reference sites for each MPA have been identified, a suite of potential indicators have been quantitatively assessed, disparate datasets have been combined for use in guiding development of cost-effective monitoring programs, spatial data layers synthesizing human pressures have been developed and results from older MPAs in the region are presented.

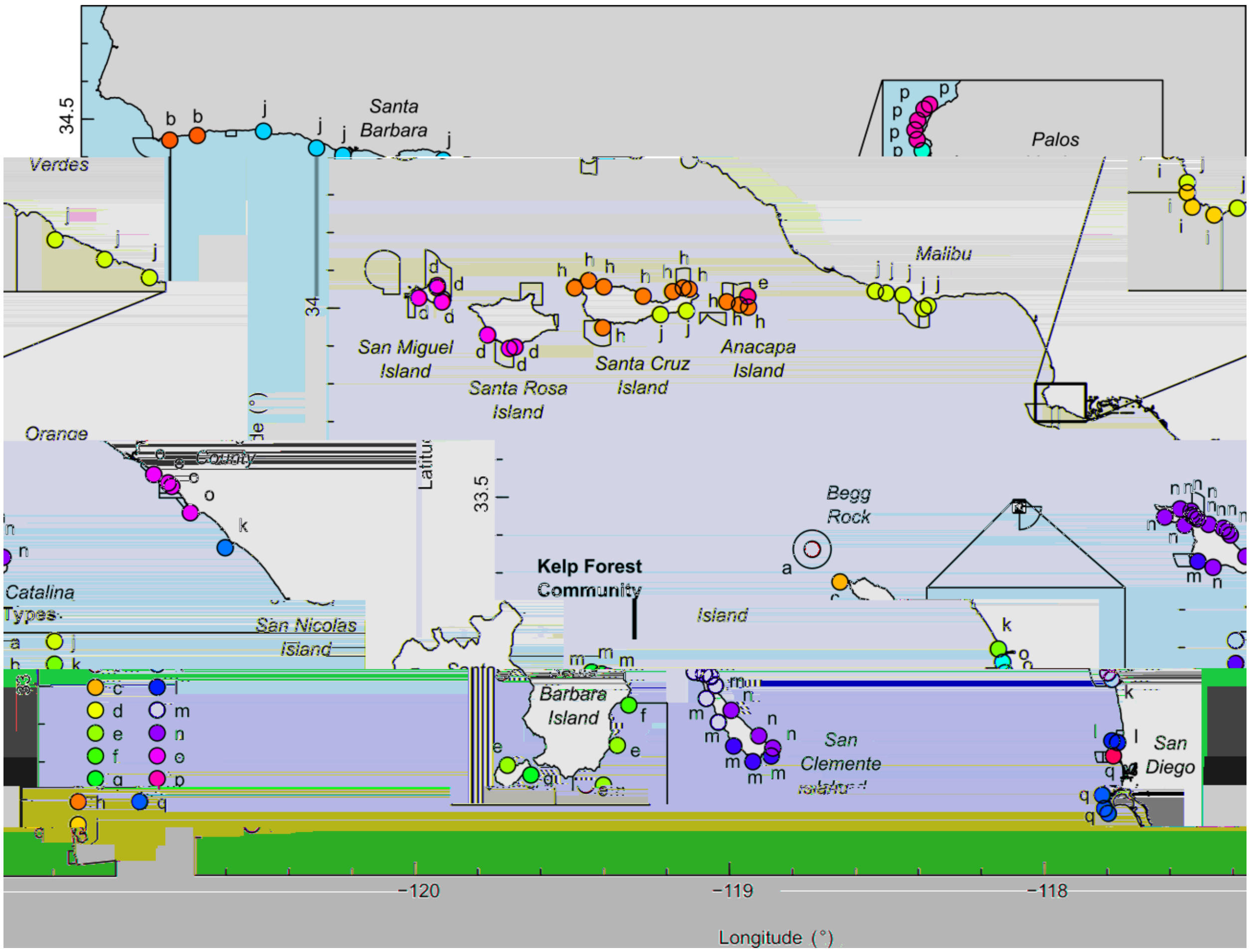


Figure ES.1. Using cluster analyses, we determined the sites surveyed during SCSR baseline monitoring program group into 17 significantly different kelp forest community types labelled a–q. This analysis incorporated differences in the density of fishes, invertebrates, and kelps observed across the study region.

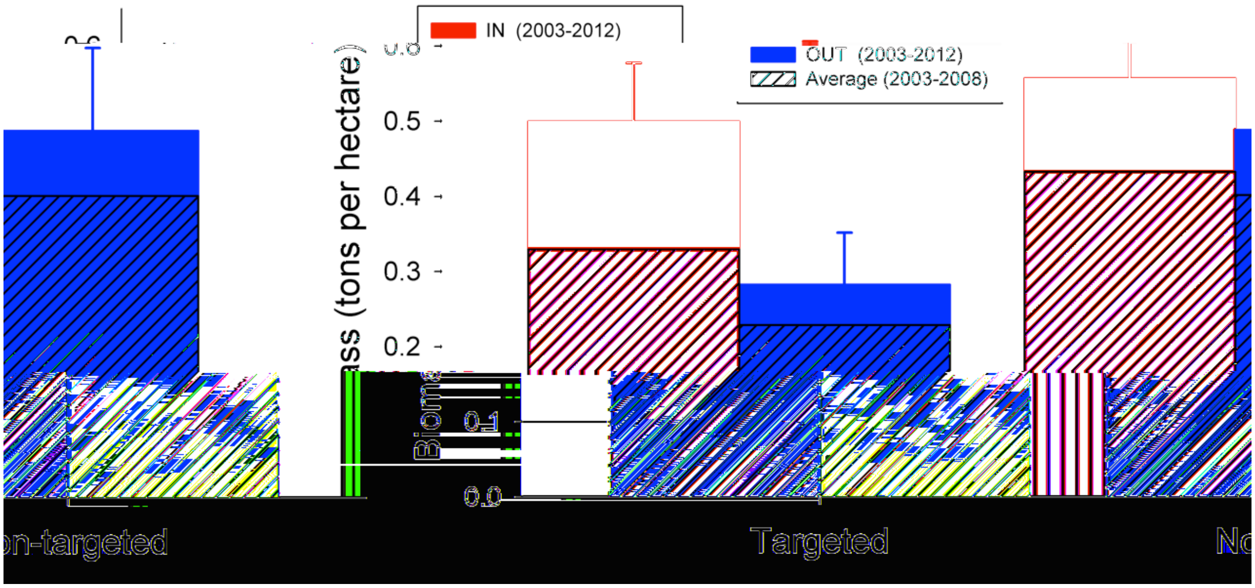


Figure ES.2. Results from the Channel Islands MPA network which was implemented in 2003, prior to the implementation of the remainder of the South Coast MLPA network. Plots show total biomass (tons per hectare) for fish species targeted by fishing and species not targeted, inside MPAs (red bars) and outside MPAs (blue bars). Red and blue bars show the ten-year average biomass (from 2003-2012, plus one standard error). The black inset bars show the same data but calculated for the first five years (average from 2003-2008).

Introduction

Background

Kelp and Shallow Rock Ecosystems

Kelp and shallow rock ecosystems are among the most productive ecosystems in the world, and are iconic features along the coast of California providing services that span commercial and recreational consumptive uses and a diverse array of non-consumptive services (e.g., tourism, diminishing coastal erosion). Kelp beds and rocky reefs provide food, shelter, and habitat for a rich diversity of ecologically and economically important species, while drift kelp and dissolved organic matter from kelp provide an energetic resource to populations of species both within and around kelp beds (Duggins et al. 1989; Tegner and Dayton 2000; Graham et al. 2007). In southern California, kelp beds and rocky reefs support valuable commercial and recreational fisheries that target a diverse array of fishes (e.g., California Sheephead (*Semicossyphus pulcher*), Kelp Bass (*Paralabrax clathratus*), and rockfishes (*Sebastes sp.*) and invertebrates [e.g., Red Urchins (*Strongylocentrotus franciscanus*), California Spiny Lobster (*Panulirus interruptus*), sea cucumbers *(Parastichopus parvimensis* and *P. californicus*)]. The Red Urchin fishery, for example, is one of the highest value fisheries in California, with about two-thirds of all landings caught within the Northern Channel Islands (CDFG 2006).

Over the last few decades there has been a general trend of declines in kelp forest biomass throughout southern California. For instance, despite being in a strong La Nina pattern with some of the strongest kelp growth in recent memory, 37 of 49 mainland kelp beds from Ventura to San Diego county have decreased in canopy coverage or have disappeared over the last three decades (MBC 2013). There remains a heated debate concerning the causes of that decline and whether kelp forest loss is a result of overharvesting of predators on kelp grazers (e.g., CA sheephead, spiny lobster, southern sea otters) (Behrens and Lafferty 2004) or anthropogenic changes in water quality from historic sewage discharge into nearshore environments (Foster and Schiel 2010). Fishing effects and water quality are important drivers of kelp forest ecosystem health and the relative importance will vary across the region, which includes island locations far from sources of pollution and mainland sites adjacent to large human populations. There is also a significant stress on these nearshore systems due to sedimentation, associated turbidity, scour and reef burial (Pondella 2009; Pondella et al. 2010). Monitoring Marine Protected Areas (MPAs), which controls for the effects of fishing while not affecting water quality *per se*, should allow more insight into the debate. For this reason, monitoring and assessment of kelp and nearshore rocky reefs throughout the entire region, including both mainland and island sites, is of particular importance.

Study Region

The Marine Life Protection Act (MLPA) South Coast Study Region (SCSR) ranges from Point Conception in Santa Barbara County to the California/Mexico border and includes the state waters on the mainland coast as well as the Channel Islands (Figure 1). The southern California coastline is 1197.2 km in length with the eight Channel Islands coastlines extending 502.7 km and the mainland coastline measuring 694.5 km. This comprises about half of the entire coastline for the State. Approximately 122 delineated rocky reefs are found in the SCSR (Pondella et al. 2011). At the islands, 377.4 km (75.1%) of the coastline has rocky reefs offshore, while the mainland has rocky reefs offshore of 176.2 km (25.4%) of the coastline. Not only does the nearshore proportion of rocky reef to soft-bottom habitats vary between the Channel Islands and the mainland, but the physical structure of these reefs is markedly different. Offshore pinnacle and island reefs are primarily high relief, abrupt reefs which are tightly fit to the shoreline, while mainland reefs exhibit a mosaic of habitat types and are generally on gentler slopes that extend well offshore of the littoral zone (Ebeling 1980; Pondella et al. 2011). This variation in reef composition significantly affects the assemblages in these disparate systems (Pondella and Allen 2000). In addition to the physical variation in structure and type of rocky reefs, mainland reefs (with the exceptions of Palos Verdes and Point Loma) are within the four littoral cells for nearshore sand transport creating a structurally different physical setting in terms of the benthos (Inman and Frautschy 1966; Patsch and Griggs 2006) (Figure 2). This is further complicated by "beach nourishment" (i.e., extensive beach building and maintenance) and "sand bypassing" (i.e., returning sediment to the system that has been moved by harbors, lagoon entrances, or jetties) programs in some parts of the SCSR, which have added millions of cubic yards of beach-quality sand to beaches over the last two decades (Figure 2) (SANDAG 2010). Both of these activities can influence the benthic rocky reefs offshore of those beaches; creating reefs that are influenced and/or covered by moving sand (Peterson and Bishop 2005). Ongoing sedimentation and turbidity concerns are also associated with the Portuguese Bend Landslide on the Palos Verdes Peninsula (Pondella et al. 2010) (Figure 2). Any expectations or explanations of biological performance of MPAs is structured by the habitat characteristics of this system.

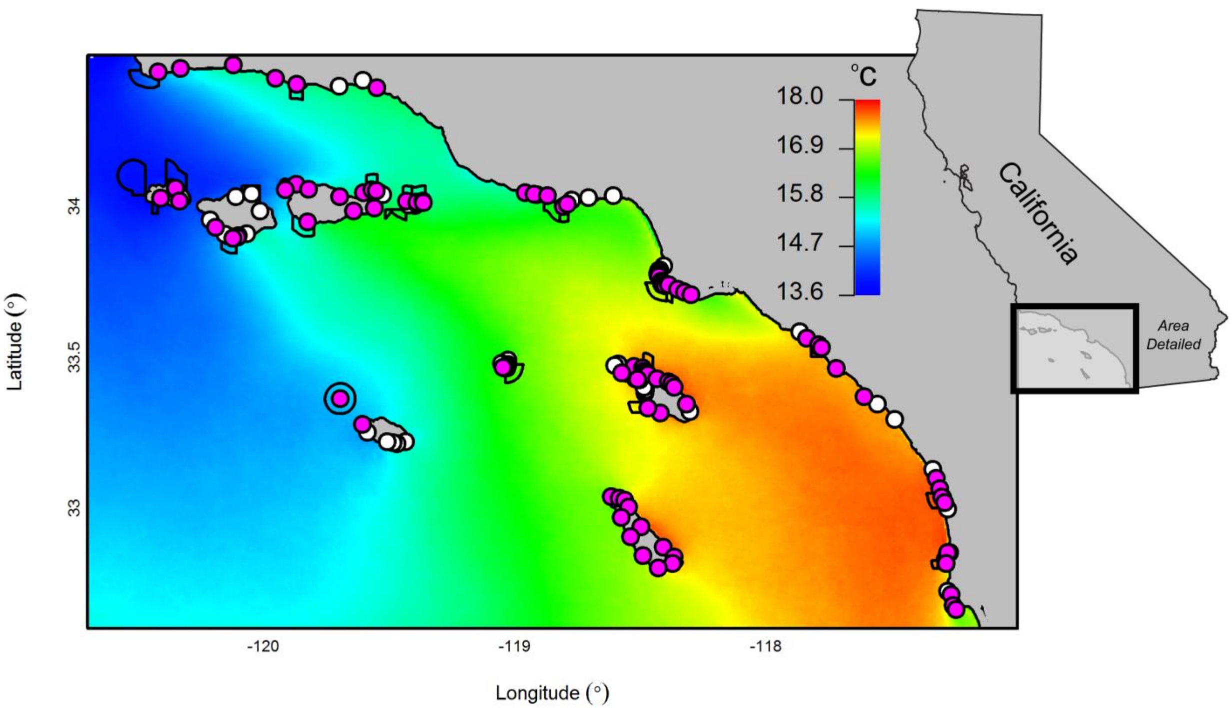


Figure 1. Map of the kelp and shallow rock ecosystem sites sampled as part of the SCSR MPA Baseline Monitoring Program (magenta circles; 2011: 75 sites; 2012: 88 sites) and in the historical database (white circles, most plotted beneath 2011 and 2012 sites; 2004: 59 sites; 2008: 79 sites) with mean Sea Surface Temperature (MODIS SST) from 2000-2012.

A large human population, sensitive marine ecosystem and the unique conditions of the Southern California Bight combine to create a diverse and complex ecosystem. The SCSR is located in the southern portion of the CA current ecosystem, one of the most productive regions in the world. Importantly, the SCSR is situated directly south of Pt. Conception, where the cooler, equator-ward flowing California Current meets the relatively warmer, poleward flowing California Countercurrent. The confluence of these two oceanographic currents marks the interface between two biogeographic provinces, each with distinct biota and ecosystems: the Oregonian province to the north (and extending to parts of the Channel Islands) and the San Diegan (or Californian) province to the south (Hubbs 1960; Horn and Allen 1978; Murray and Littler 1981; Pondella et al. 2005). Overall this region is characterized by a strong environmental gradient in sea surface temperature (SST) (Figure 1), and large variation in productivity and exposure to waves and storms over a relatively short geographic distance. This is a major difference separating the SCSR from the other California MLPA Study Regions that have relatively more consistent environments across each region.

Beyond the known physical and biological challenges for the Southern California Bight, this region is unique in the State in terms of population (17 million, US 2010 census). Due to this population, the Bight's size, and its mild climate, all factors enhancing accessibility, it is no surprise the SCB supports $41 billion in ocean-dependent tourism and over 800,000 jobs (NOEP 2008). This puts an enormous amount of pressure on nearshore resources, the immediate interface to the population. As such, two critical factors of this ecosystem necessary for contextualizing nearshore resources are fishing (commercial and recreational) and pollution. As parallel studies to this baseline assessment, spatial patterns in fishing pressure and pollution across the SCSR were characterized as part of the Bight '13 project organized by the Southern California Coastal Water Research Project (SCCWRP) (For more information on the Bight '13 project see http://bit.ly/1sDQopT). These results are summarized and discussed here (see Historical Trends).

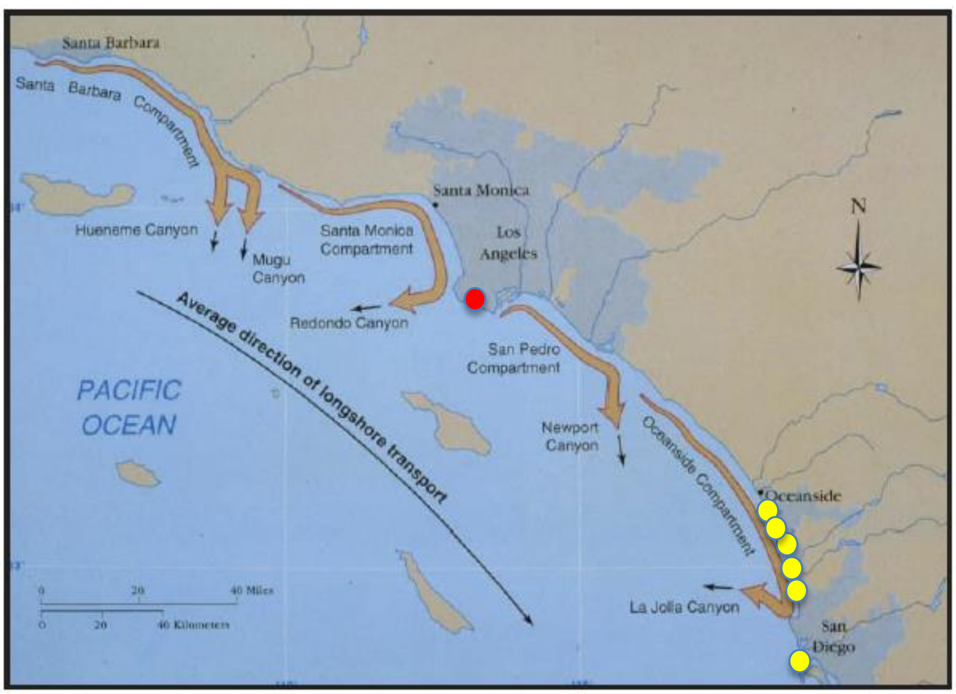


Figure 2. Littoral cells in southern California (from Figure 2.3 in Patcsch and Griggs 2006). Locations of San Diego County beach nourishment and sand bypassing sites (yellow circles) (from SANDAG 2010) and the Portuguese Bend Landslide on the Palos Verdes Peninsula (red circle) are also shown.

The SCSR is one of the better-studied regions in California's MLPA process. Large spatial scale time series and MPA assessments have been completed in this region primarily by the Vantuna Research Group (VRG) and the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO). Here we present results from a two-year baseline study of the MLPA MPAs in the SCSR. We also integrate these newest surveys (2011-2012) with data from two southern California-wide surveys that took place in 2004 (Cooperative Research and Assessment of Nearshore Ecosystems - CRANE) and 2008 (Bight '08) (Figure 1), and present summaries of other data (e.g., large-scale environmental conditions, water quality, fishing pressure, monitoring of the northern Channel Islands MPAs established in 2003) to provide additional historical context to the baseline characterization of shallow rocky reef and kelp forest ecosystems in the SCSR. While SST is one of the major drivers of reef community structure (Stephens et al. 2006), it is just part of an extremely complex physical oceanographic setting that varies spatially and temporally in current structure, wave exposure, upwelling centers and oceanographic forcing (Hickey 1993).

Goals and Objectives

The *overall goal* of this project was to describe the ecological conditions of kelp and shallow rock ecosystems inside and outside of MPAs in the SCSR of the MLPA and to integrate these baseline surveys together with historical data to illustrate changes in conditions over both short and longer time scales. The *specific objectives* of the surveys and analyses were to:

(1) produce a quantitative baseline characterization of the structure of kelp and shallow rock ecosystems in MPAs in the SCSR through SCUBA surveys utilizing techniques similar to those used in other MLPA regions,
(2) provide quantitative comparisons between kelp and shallow rock ecosystems inside the MPAs and associated reference areas outside MPAs,
(3) integrate data from the proposed baseline survey with existing long-term data to describe current trajectory of ecosystem trends,
(4) describe large-scale environmental conditions, water quality metrics, spatial patterns in fishing pressure, dynamics of recruitment and trajectories of change in the longer established MPAs in the SCSR to provide a broader context from which to evaluate SCSR baseline conditions and future assessments of MPA performance,
(5) evaluate candidate system indicators from the SCSR monitoring plan and examine potential new candidates,
(6) and inform future monitoring methods while optimizing integration of existing long-term data sets with future monitoring data.

Methods

Sampling Methods

Our sampling approach is based on protocols developed for long-term monitoring by PISCO. These methods were also previously used in the Central Coast Study Region (CCSR), the North Central Coast Baseline program (NCC), the network of marine reserves in the northern Channel Islands (NCI) and the Cooperative Research and Assessment of Nearshore Ecosystems (CRANE) program. We conduct four types of diver surveys to characterize the rocky reef and kelp forest ecosystem: 1) fish density and size distribution are recorded along belt transects on the reef surface, mid-portion of the water column, and top-portion of the water column when kelp canopy is present, 2) density of large (> 2.5 cm) invertebrates and stipitate algae are recorded along "Swath" transects on the reef, 3) percent cover of sessile invertebrates, turf algae, and geologic habitat characteristics are estimated from uniform point contact (UPC) along transects on the reef, and 4) size frequency data for the commercially and ecologically important invertebrates such as red and purple urchins, abalone and other key species. Further description of the PISCO survey methods with datasheets and training materials can be found here: http://www.piscoweb.org/research/science-by-discipline/ecosystem-monitoring/kelp-forest-monitoring/subtidal-sampling-protoco#FishSurvey

All surveys are conducted by teams of SCUBA divers that access sample sites from research vessels. A single site consists of at least 250 m of coastline. Within each site, surveys are conducted subtidally up to 30 m depth, depending on the deepest extent of rocky reef habitat present. Sampling is stratified across zones defined either by a general depth zone classification (inner, middle, outer, deep) or proximity to shore (onshore to offshore sections of the reef) to ensure surveys capture variation in species occurrence across these gradients. The basic unit of sampling is the transect. Our survey design is based on analytical models that allow us to describe the direction and magnitude of change in kelp forests over time. To achieve this, we sample randomly located transects within each of the stratified zones at each site. We discuss the survey design and sampling methods below.

Fish Survey Design

At each monitoring site, visual surveys by scuba divers are used to quantify the size structure and density of fish populations and the species composition and structure (i.e., relative abundance) of fish assemblages. To assure that the 3-dimensional habitat created by kelp forests is sampled thoroughly, fish transects are stratified across the face of the reef (alongshore and cross-shore) and vertically through the water column. Within each cross-shore 'zone', three to four randomly located transects are sampled along isobaths (constant depth) parallel to shore. The zones at each site are stratified to encompass the offshore edge of the reef, the middle of the reef, and as shallow inshore as practical. For example, for a reef with a maximum depth of 25 m the target depths for the zones would be 5, 10, 15, and 25 m. If no appreciable depth stratification is present, then either the non-existent zones are omitted, or the stratification is based on proximity to the outer edge of the reef and the shore.

Fish Sampling Methods

Three portions of the water column (bottom, midwater and canopy) are sampled by two divers along each transect. Bottom transects sample the bottom 2 m of the water column, contiguous with the reef surface, and the midwater transect is located above the bottom transect. The height of the midwater transect varies as a function of bottom depth (4-6 m above the bottom for bottom depths of 10 m or greater, 2-4 m above the bottom for bottom depths of 6 m or less). Bottom and midwater transects are sampled simultaneously by two divers. After completion of bottom and midwater transects, divers move up to the canopy and, moving in the opposite direction, count fish in the top 2 m of the water column (0-2 m depth) only. Both divers in the team identify, count and size all conspicuous fishes on each 30 m long x 2 m tall x 2 m wide transect. If sex is visually distinguishable [e.g., California Sheephead (*Semicossyphus pulcher*)], this is recorded as well. As they reel out a 30 m tape, divers estimate total length (TL) of small fish (< 30 cm TL) to the nearest cm, and larger fish (> 30 cm) to the nearest 5 cm interval. If a school of fish is encountered that is too large to size individuals, the number of fish is estimated within size bins. Physical data collected on each fish transect includes observation depth (m), water temperature (C^{o}), horizontal visibility (m), surge (0-4 relative scale), and kelp canopy cover (%).

Invertebrate and Algae Survey Design

At each monitoring site, visual surveys by scuba divers are used to quantify density of macroalgae and invertebrate populations and the species composition and structure (i.e., relative abundance) of their assemblages. To assure that the entire kelp forest is sampled representatively, benthic transects are stratified across the face of the reef (alongshore and cross-shore). Within each cross-shore 'zone', two to three randomly located transects are sampled along isobaths (constant depth) parallel to shore. The zones at each site are stratified in a manner similar to the fish survey transects, and designed to encompass the offshore edge of the reef, the middle of the reef, and as shallow inshore as practical.

Two sampling methods are used to quantify the density and/or cover of algae and invertebrates along each transect. Swaths (or belt transects) are used to estimate the density of species (or species groupings) while uniform point contact (UPC) is used to estimate the cover of species (or species groupings). In addition to sampling biotic cover; the UPC method is used to estimate the percent cover of substratum type and relief. Each transect is sampled by two divers with each diver conducting one technique. The size structure of select commercially and/or ecologically important invertebrates was measured in each zone at each site. Physical data collected on each invertebrate/algae transect includes transect depth (m), water temperature (C^o), horizontal visibility (m), and surge (0-4 relative scale).

Swath Methods

The purpose of the swath sampling is to estimate the density of conspicuous, solitary and mobile invertebrates as well as specific macroalgae. Individual invertebrates (larger than 2.5 cm) and macroalgae are counted along the entire 30 m x 2 m transect. Cracks and crevices are searched and understory algae pushed aside. Any organism with more than half of its body inside the swath area is counted. The following minimum size criteria are also applied when counting macroalgal species:

- Giant Kelp (*Macrocystis pyrifera*) taller than 1 m; number of stipes counted at 1 m above the substrate; *Macrocystis* is not subsampled
- Bull Kelp (*Nereocystis luetkeana*), Elk Kelp (*Pelagophycus porra*), Pom Pom Kelp (*Pterygophora californica*), Southern Stiff-Stiped Kelp (*Laminaria setchellii*) and Southern Sea Palm (*Eisenia arborea*) taller than 30 cm
- Oarweed (*Laminaria farlowii)* and Fringed Sieve Kelp (*Agarum fimbriatum*) greater than 10 cm wide
- Chain Bladder Kelp (*Cystoseira osmundacea*) greater than 6 cm wide

Very high densities of some species of invertebrates and algae prohibit enumeration along the entire length of a swath. We use a 'variable area subsampling' technique. Transects are divided into three 10m segments. Species that occurred in high densities (e.g., Purple Urchins) may be subsampled if greater than 30 individuals occurred within any of the three 10-m segments on a transect. When species are subsampled, the diver records the meter mark at which the threshold abundance is reached and then stops counting that species for the remainder of that segment. The species continues to be counted at the start of each following segment. The subsampled abundances are then extrapolated per segment to calculate an estimated total abundance per transect.

Uniform Point Contact methods

Uniform point contacts (UPCs) are used to estimate the percent cover of species and reef attributes along each 30 m long transect. Divers record three types of information beneath 30 points located at every meter along a transect: 1) substrate type, 2) physical relief, and 3) benthic cover of spaceoccupying organisms and abiotic cover types. At each sampling point, the transect line is pushed down and the taxa directly under the point is recorded. The purpose is to re-create a two-dimensional, "photo style" representation of the percent cover of organisms that are directly attached to the primary substrate. Therefore, epiphytes, epizooids, and mobile organisms are not included.

In addition to benthic cover, reef attributes are measured on UPC transects. Substrate type is defined as: bedrock (> 1 m), boulder (10 cm-1 m), cobble (<10 cm), or sand. Physical Relief is defined as the maximum vertical relief (0-0.1 m=Flat, 0.1-1 m=Low, 1-2 m=Moderate or > 2 m=High) within a square centered on the point with 1 m length and width.

Invertebrate Size Structure methods

In order to gain a more accurate estimate of the size frequency distribution of species of economic and/or ecological importance, specimens are collected and measured at each depth zone in the areas on and around each transect. The following species are measured:

- Purple Urchin (*Strongylocentrotus purpuratus*), Red Urchin (*S. franciscanus*), Giant Keyhole Limpet (*Megathura crenulata*), Wavy Turban Snail (*Megastraea undosa),* Kellet's Whelk (*Kelletia kelletii*): we targeted up to 100 individuals of each species in each depth zone for sizing. Individuals are collected, brought to the surface, measured to the nearest mm and returned to the reef. Collections are made from multiple areas of each depth zone when possible. To avoid bias, all emergent individuals are collected from a given patch or as seen on the reef.
- Red Abalone (*Haliotis rufescens*), Pink Abalone (*H. corrugata*), Green Abalone (*H. fulgens*), White Abalone (*H. sorenseni*), Pinto Abalone (*H. kamtschatkana*), Threaded Abalone (*H. kamtschatkana assimilis*), Black Abalone (*H. cracherodii*): Every abalone encountered is identified and measured to the nearest centimeter without removing the animal from the substrate.
- California Spiny Lobster (*Panulirus interruptus*): Carapace length is estimated to the nearest centimeter for each lobster encountered without disturbing the individual.

SST

Long-term averages of sea surface temperature (SST) for all sites was obtained from merged MODIS 1 km resolution data from MODIS-Aqua and MODIS-Terra composited over 15-day intervals by the California Current Ecosystem Long-term Ecological Research program based at Scripps Institution of Oceanography (available from http://spg.ucsd.edu/Satellite_data/California_Current/). We averaged these over the entire period available from 24 February 2000 through 31 December 2012 (Figure 1).

Descriptions and Location of Sites and Rocky Reef Data Sources

Multiple data sources were used in the creation of this report. Both PISCO and VRG have well established, long-term monitoring programs in southern California and both have been heavily engaged in previous large-scale collaborative surveys. The core data were gathered as part of this project (hereafter referred to as SCSR Baseline or simply Baseline). Baseline surveys were conducted in 2011 (n=75 sites) and 2012 (n=88 sites) throughout the SCSR at a total of 94 unique sites (Figure 3, APPENDIX A. Table A.1). Historical data included data collected as part of the Cooperative Research and Assessment of Nearshore Ecosystems (CRANE) program in 2004 and the Southern California Bight 2008 Regional Monitoring Program (Bight '08). The majority of CRANE and Bight '08 data were collected by

PISCO and VRG, though other groups collaborated in both projects. CRANE surveys were conducted at 59 sites and Bight '08 data were collected at 79 sites (Figure 1, APPENDIX A. Table A.1). Additionally, PISCO has been monitoring the NCI MPA network yearly since its implementation (2003) with their standard protocols. These data are used to describe key findings related to trajectories of change across the NCI network over a period of 10 years since MPA implementation in order to provide additional insight into expected timelines of change for the other recently implemented MPAs in the SCSR. More information on these historical data sets can be found here:
CRANE: http://www.dfg.ca.gov/marine/fir/crane.asp
Bight '08: http://bit.ly/1trZdES
PISCO: http://www.piscoweb.org

Due to the abundance of historical data from the region gathered by the PIs, site selection focused initially on sites that had been previously surveyed. We constructed a prioritization scheme that took into account the following factors: length of existing time series from previous data collection (e.g., core PISCO sites, core VRG sites, CRANE sites, Bight '08 sites), location (e.g., sites located inside and outside of MPAs, sites in each biogeographic region) and accessibility (e.g., military closures, diving conditions). There were a variety of factors that influenced the choice of sites from the historical programs for use in the Baseline study. For example, PISCO sites were initially chosen to survey large-scale biogeographic patterns and were paired with intertidal and oceanographic mooring locations. Later PISCO and VRG sites were selected specifically for potential MPA monitoring, taking into account similarity of habitat characteristics for each pair (when possible) based on best professional judgment. Details of site selection for each monitoring program can be found in the above links.

Analytical Methods

Fish Data Processing

Prior to analysis, filter criteria were applied to remove fish species or size classes that would disproportionately weight the data toward a certain site for certain statistics. Pelagic species that are not characteristic inhabitants of rocky reef habitats or are highly mobile [e.g., Northern Anchovy *(Engraulis mordax*), Bonito (*Sarda chiliensis*), Pacific Chub Mackerel (*Scomber japonicus*), Pacific Barracuda (*Sphyraena argentea*)] were excluded from the data set for all analyses because they occurred infrequently, but when they were present they generally occurred in very large numbers. Additionally, because sites were sampled over a time period of several months and seasons, young-of-the year (YOY) were removed prior to density calculations (i.e., abundance/60 m^2 transect) because they could numerically dominate the assemblage at some sites sampled early during the sampling season but decline later in the year as a result of natural mortality. YOY were generally defined as fishes < 10 cm, except for some smaller species, where they were defined as individuals less than between 1.5 and 5 cm based on published species-specific growth rates and expert opinion. Total length (TL) estimates were converted to biomass using standard species-specific length-weight conversions from the literature or FishBase (FishBase 2012). YOY were not excluded from biomass calculations, as their small size will influence biomass estimation less than abundance estimation. Density or biomass density was then summed across all three portions (bottom, midwater and canopy) of each transect, except for when the water depth is less than 6 m, meaning that the volumes of the canopy and midwater portions would overlap, in which case no midwater portion was included. Density values were then scaled to number per 100 m^2.

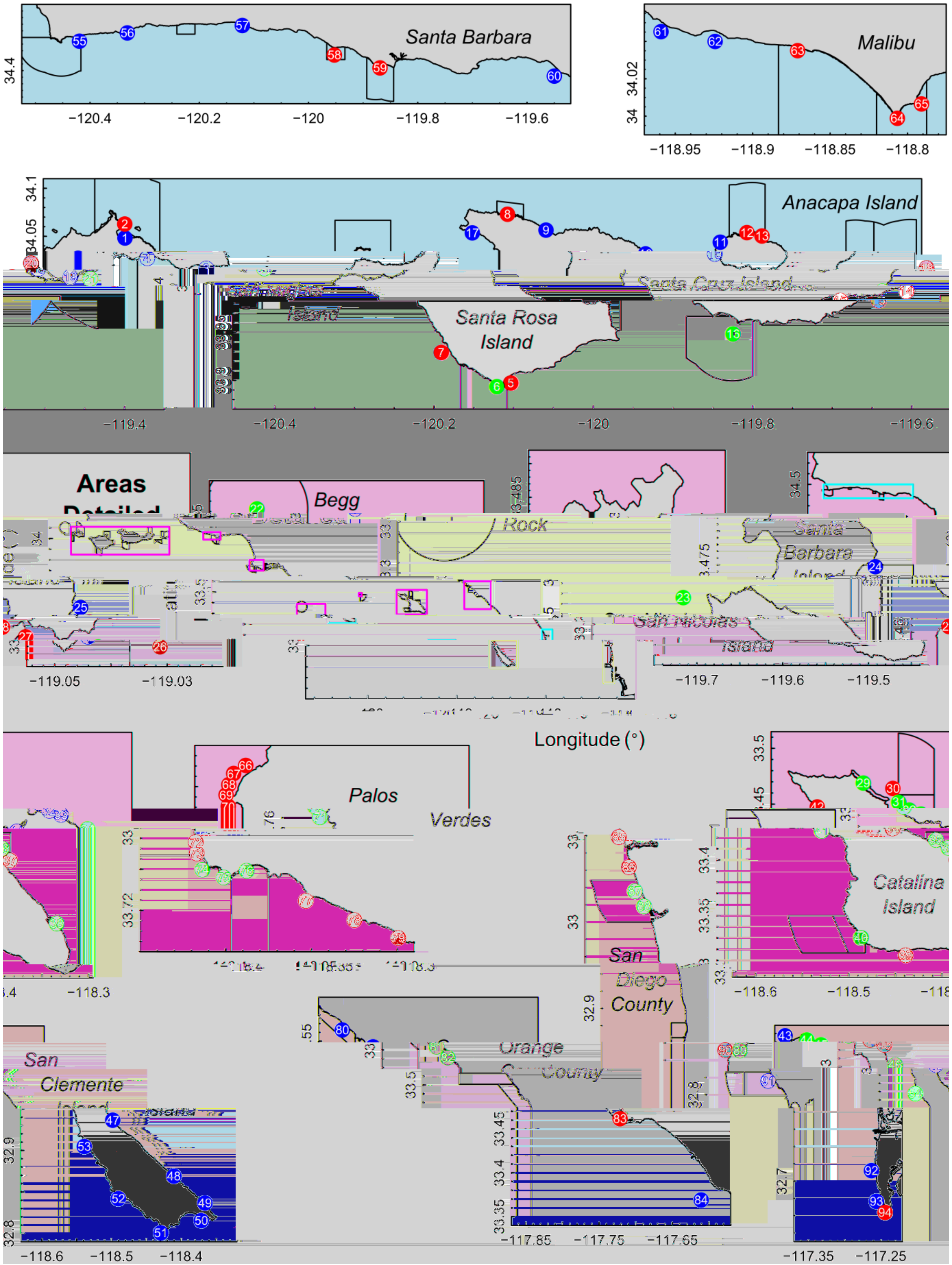


Figure 3. Locations of 94 sites sampled during 2011 and 2012. The boundaries of current MPAs are outlined and sites located within them are in red, while sites outside MPAs are in blue.

Baseline Characterization (Community Analyses)

As part of the quantitative baseline characterization of the structure of kelp and shallow rock ecosystems in the SCSR, we first examined large-scale geographical patterns in the overall kelp forest community using the fish and swath (benthic macroinvertebrates and kelps) data combined. The overall number and geographic distribution of significantly different kelp forest community groups were determined using a cluster analysis with a SIMPROF test (alpha = 0.01) performed with the 'simprof' function in the 'clustsig' package (Clarke et al. 2008; Whitaker and Christman 2014) in R (R Core Team 2013). The analysis was performed using a similarity matrix constructed with square root-transformed taxon-specific values (site means averaged across 2011 and 2012) and the Bray-Curtis similarity coefficient. We also ran this analysis again using Giant Kelp (*Macrocystis pyrifera)* stipe density (stipes per 100 m^2) instead of the density of Giant Kelp individuals (results presented in Appendix B). Due to high potential variation in the number of stipes per Giant Kelp individual, the use of total individual density may bias the results by down-weighting Giant Kelp relative to other kelps, therefore Giant Kelp stipe density has often been used in other studies of giant kelp abundance. To visualize differences in the kelp forest community groups we plotted the average density of fishes, invertebrates and kelps by kelp forest community group. For clarity in the figures, with the diverse fish and invertebrate assemblages, we included taxa that account for at least 10% of the density within any of the communities with all remaining taxa pooled into an 'other' category.

We then examined large-scale geographical patterns for specific community types (i.e., fishes, benthic macroinvertebrates, kelps and benthic cover type). For each community type a separate analysis was performed using a similarity matrix constructed with transformed taxon-specific values (site means averaged across 2011 and 2012) and the Bray-Curtis similarity coefficient. Density metrics were square root transformed (fish and swath data), while percent-cover metrics (UPC benthic cover data) were arcsine square root transformed. Kelp community analyses were run twice using either Giant Kelp (*Macrocystis pyrifera)* individual density or Giant Kelp stipe density (stipes per 100 m^2). Two-dimensional, non-metric multidimensional scaling (nMDS) was used to examine patterns among communities at sites using the 'metaMDS' function in the 'vegan' package (Oksanen et al. 2013) in R (R Core Team 2013). To provide an environmental context to the observed relationships amongst sites, patterns of sea surface temperature (SST) were also visualized across the nMDS ordination plots using the 'ordisurf' function in the R package 'vegan' (Oksanen et al. 2013; function defaults used) which fits a smooth surface using generalized additive modeling (GAM) with thin plate splines (Wood 2003; Oksanen et al. 2013).

Previous studies using fish communities performed on an island scale in the NCI demonstrated the statistical benefit of incorporating biogeography (i.e., analyzing effects separately within biogeographic groups) when evaluating impacts of MPAs (Hamilton et al. 2010). Therefore, "Geographic Areas" within the SCSR were *a priori* defined based on the kelp forest community cluster analysis described above, geographic location (island vs. a mainland area), and known biogeographic and habitat breaks. To examine the validity of the defined Geographic Areas (i.e., whether sites within each Geographic Area grouped were more similar to each other than they were to sites in other Geographic Areas) we first tested for a significant difference amongst Geographic Areas using the 'adonis' PERMANOVA function and tested for homogeneity of multivariate dispersions with the 'betadisper' function (both functions from the R 'vegan' package; Oksanen et al. 2013). If there are significant differences in the multivariate dispersions among sites within Geographic Areas then PERMANOVA results should be interpreted with additional caution (Anderson 2006). This was followed by tests for significant pairwise differences amongst Geographic Areas (Hamilton et al. 2010). Due to lack of site replication (i.e., only one site within the Geographic Area), the San Nicolas Island Geographic Area and the Begg Rock Geographic Area were not included in the analyses comparing Geographic Areas.

Additionally, to inform whether MPA and Reference sites are well matched, we assessed multivariate habitat differences in both the substrate type and physical relief reef attributes. In each case, the input data involves points along UPC transects being identified as in one of four categories (see uniform point contact methods). We used the R 'adonis' PERMANOVA function to test for significant differences in the multivariate structure for each metric between MPA and Reference sites within each of the Geographic Areas.

Results and Discussion

Baseline Characterization

Spatial Variation in Biogeographic Community Structure of Kelp Forest Communities

The focus of our baseline characterization is on biogeographic patterns across the SCSR. This section begins with broad patterns across kelp forest communities taken as a whole; we then focus on particular community types including fishes, invertebrates and kelps, and finally conclude with individual focal species patterns. Understanding the spatial patterns of communities at different taxonomic levels is critical to informing future monitoring efforts and appropriate scales and metrics for MPA performance assessment. Generally, we find that the SCSR region is highly variable in the structure of kelp forest communities and here we find strong relationships with SST. However, future monitoring will need to analytically incorporate other known determinants of kelp forest communities including levels of fishing, pollution, sedimentation, productivity, and exposure to waves and storms.

Kelp Forest Community

We used cluster analysis followed by a SIMPROF test to identify significant clusters among kelp forest communities (i.e., composition and relative abundance of fishes, invertebrates and species of kelp). We combined all species types for this analysis for a complete look at the kelp forest community as a whole, as was done during the implementation phase of the MPAs. For the kelp forest community as a whole, seventeen distinct community structures are distributed across a spatial gradient along the study region (Figure 4), although several clusters are made up of a single site (community types a, c, f and g). Generally, community types were clustered spatially, with separation following location in the Bight from south to north and mainland versus island locations. The offshore islands in southern CA have different characteristics than mainland sites. Rocky reefs at the islands tend to contain less sand and fine sediment, are often higher relief, are farther from human impacts affecting water quality and have different fishing impacts. The north to south patterns of community structure in southern CA are well documented and likely related to SST (e.g., Pondella et al. 2005; Blanchette et al. 2008; Blanchette et al. 2009), which we explore further in analyses of specific community types (below). Overall, we show very strong spatial structuring of kelp forest communities in the Southern California Bight, indicating that MPAs are likely to show differential patterns of change depending on their exact species makeup. For fishes, one can visualize the differences between cold-water communities by the presence of cold-water species such as Blue Rockfish (*Sebastes mystinus*) and the absence of species with warm-water affinity such as Kelp Bass (*Paralabrax clathratus*) (Figure 5). Other differences in density are subtle but distinguish mainland and islands sites [e.g., species of silversides (Atherinopsidae) more abundant on the mainland, Blacksmith (*Chromis punctipinnis*) more abundant at island sites]. For invertebrates, there were strong differences in the density of both Purple and Red Urchins (*Strongylocentrotus purpuratus* and *S. franciscanus*) among sites, with very low densities to the south of Palos Verdes including Santa Catalina and San Clemente islands. Generally, invertebrate densities were lower at these southern sites compared with sites further north in the Bight and the Santa Barbara Channel (SBC). Algae were much more variable among sites with no clear patterns associated with either mainland-island designation or north to south gradients. Note that when the kelp forest community cluster analysis was run again using Giant Kelp (*Macrocystis pyrifera)* stipe density (stipes per 100 m^2) in place of Giant Kelp individual density, the results were very similar. The primary exception was that sites along the Palos Verdes Peninsula were assigned to only two different community types instead of three (Appendix B. Figure B.1, B.2).

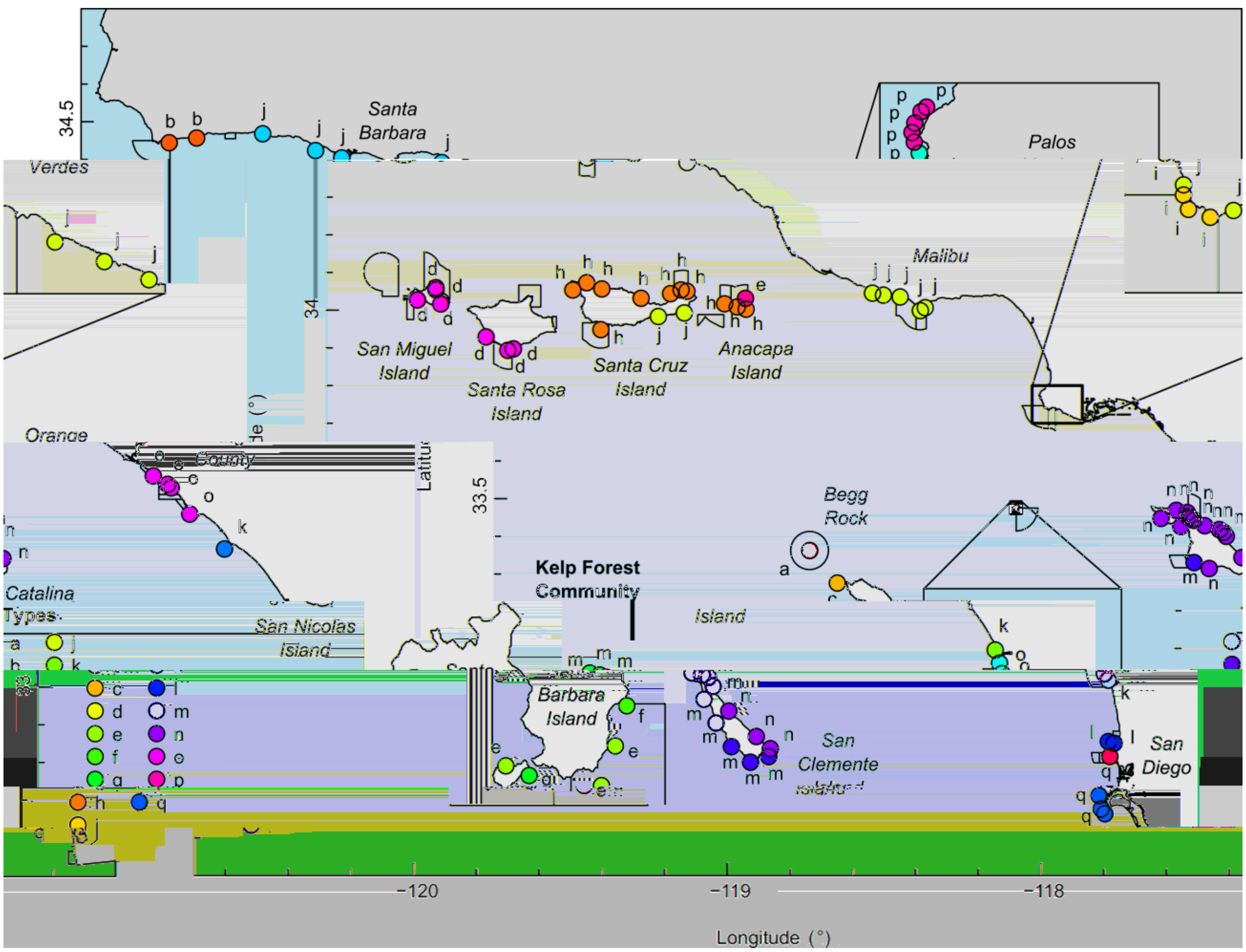


Figure 4. Geographic distribution of 17 significantly different kelp forest community types (labelled a–q) determined with a cluster analysis and a SIMPROF test (alpha = 0.01) using the Bray-Curtis similarity coefficient. The data used in the analysis were square root transformed average density of fishes, invertebrates, and kelps (site means averaged across 2011 and 2012).

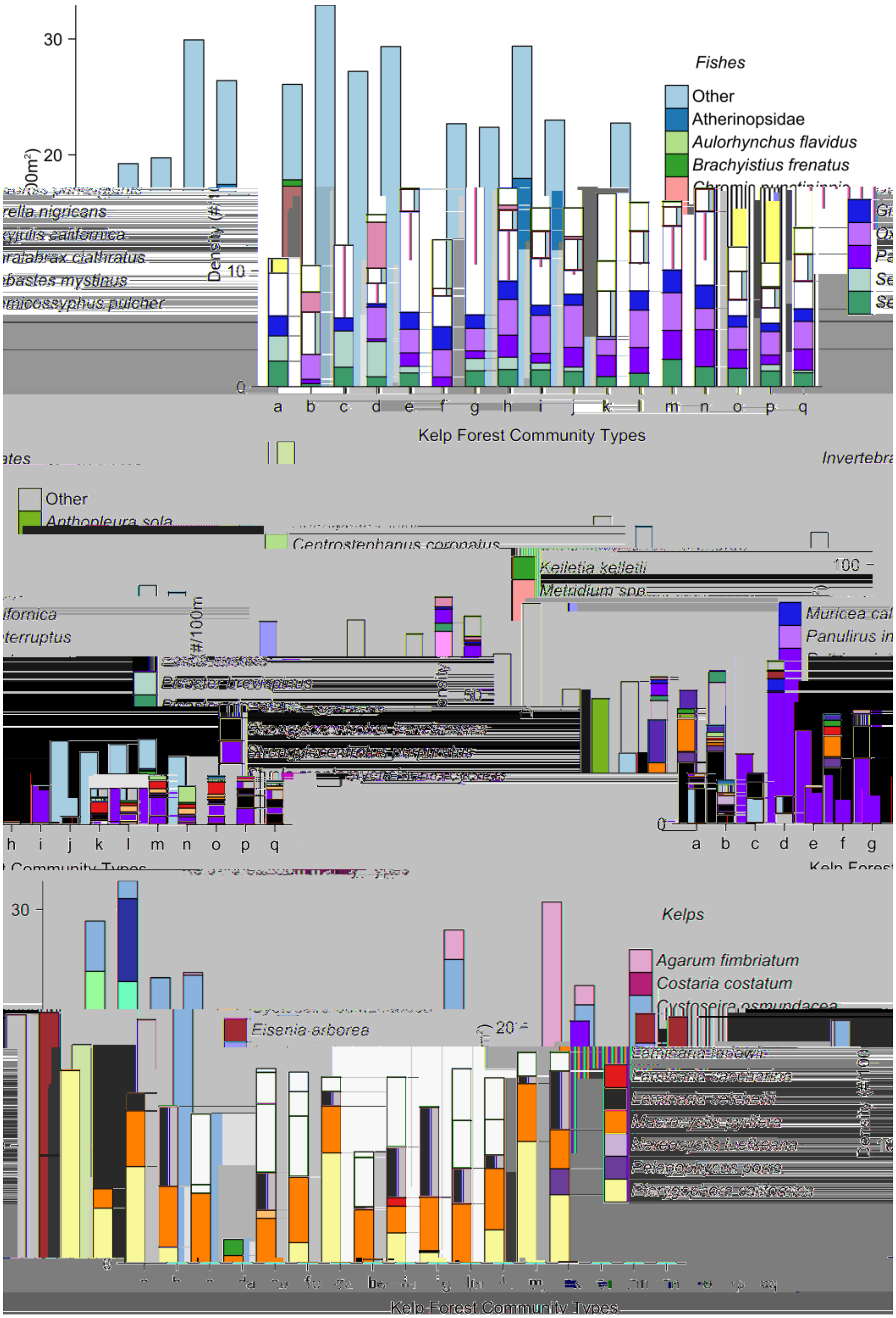


Figure 5. Average density of fishes, invertebrates, and kelps for 17 significantly different kelp forest community types labelled a–q (see Figure 4). For visual clarity, specific taxa listed in the fishes and invertebrate plots are those that account for at least 10% of the density within any of the communities. The remaining observed taxa are pooled into the 'Other' category.

Specific Community Types (Fish, Invertebrate, Kelp)

To simplify the results from the cluster analyses on total community structure and in order to provide reasonable geographic guidance to future field monitoring programs, we combined the 17 clusters described above into 14 "Geographic Areas". The 14 Geographic Areas include each island and Begg Rock separately, as well as Santa Barbara County, Malibu, Palos Verdes, Orange and North San Diego County, and La Jolla and Point Loma (Figure 3).

To delineate spatial patterns in community structure for fishes, benthic macroinvertebrates and kelps separately, we used similarity analyses [non-metric multidimensional scaling (nMDS) and PERMANOVA] on the baseline dataset for these 14 *a priori* Geographic Areas. These analyses and visualizations do not account for differences between MPA and non-MPA sites given the short duration of protection and the strong geographic differences in community structure that are known in this region from other studies (results above; Pondella et al. 2005; Blanchette et al. 2009; California MLPA Initiative 2009; Hamilton et al. 2010). Detailed analysis of MPAs and Reference sites is presented in the MPA and Reference Areas section of this report.

Results show sites presented in multivariate space overlaid on SST contour lines to better visualize the relationships between temperature and community differences. As observed above and previously in the Central and North Central Coast MLPA Study Regions, community structure (i.e., composition and relative abundance of fishes, invertebrates and species of kelp) supported by kelp forest ecosystems of the SCSR varied across the study region and was related to sea surface temperature (Figure 6-10, see also Appendix B, Table B.1-B.5).

Fish Density and Biomass

The spatial patterns of fish community structure based on both density and biomass across the SCSR were similar (Figure 6-7) with sites within each Geographic Area generally clustering together and Geographic Areas separating by both island (filled circles) and mainland (open circles), and across a clear SST gradient. For both variables, pairwise comparisons of all Geographic Areas were significantly different from one another with the exception of a few adjacent pairs of islands (*San Miguel Island and Santa Rosa Island, Anacapa Island and Santa Cruz Island, Santa Catalina Island and San Clemente Island*), and a pair of mainland Geographic Areas (*La Jolla and Point Loma* and *Palos Verdes*) (Appendix B. Table B.1, B.2). Interestingly the adjacent mainland Geographic Areas *Palos Verdes* and *Orange and North County* were significantly different from each other, likely due to break in the pattern of long-term SST that exists between the two areas (Figure 1) with the *Orange and North County* Geographic Area encompassing an area of higher SST than Geographic Areas to the north (*Palos Verdes*) and the south (*La Jolla and Point Loma*).

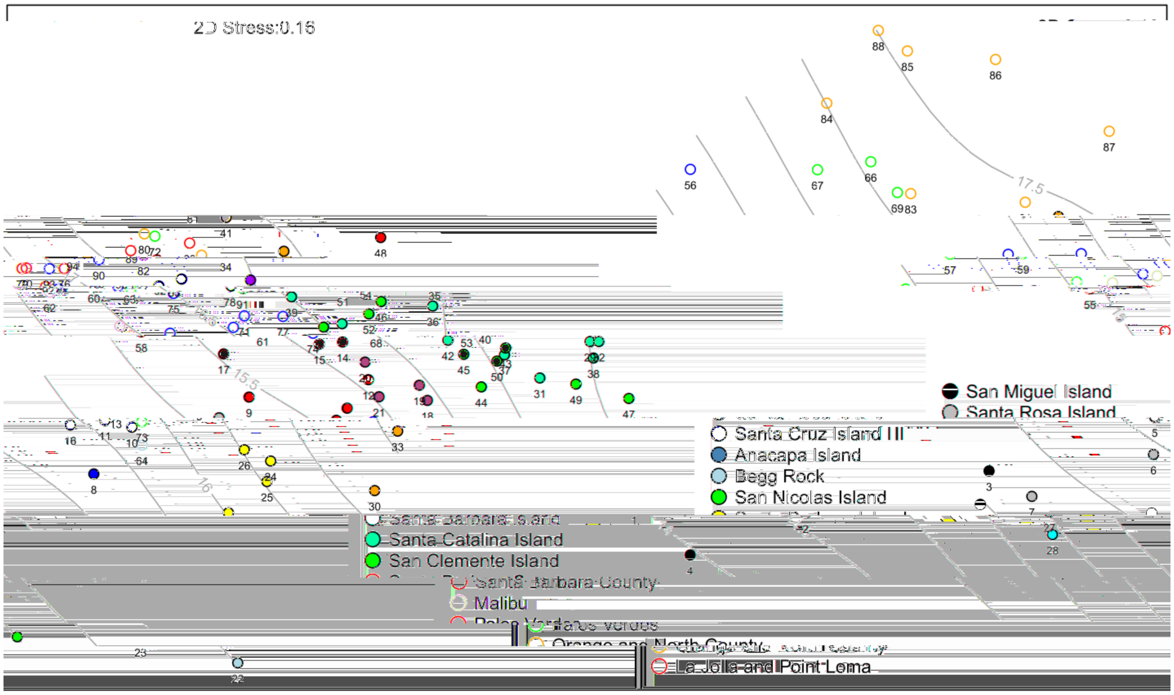


Figure 6. Non-metric multidimensional ordination plot of fish (numerical density) communities using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each of the 94 sites across the 14 Geographic Areas overlaid on a fitted SST surface (grey contour lines; °C). Sites are numbered according to Figure 3.

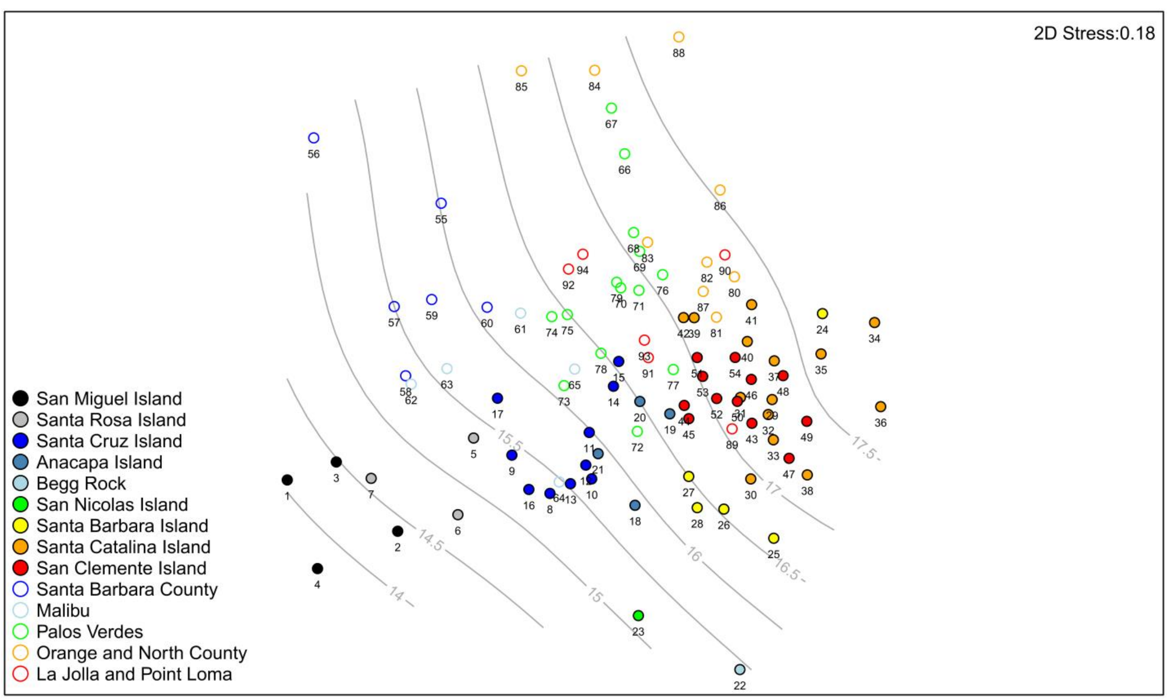


Figure 7. Non-metric multidimensional ordination plot of fish (biomass) communities using Bray-Curtis similarity based on the square-root transformed taxa biomass density averaged across 2011 and 2012 for each of the 94 sites across the 14 Geographic Areas overlaid on a fitted SST surface (grey contour lines; °C). Sites are numbered according to Figure 3.

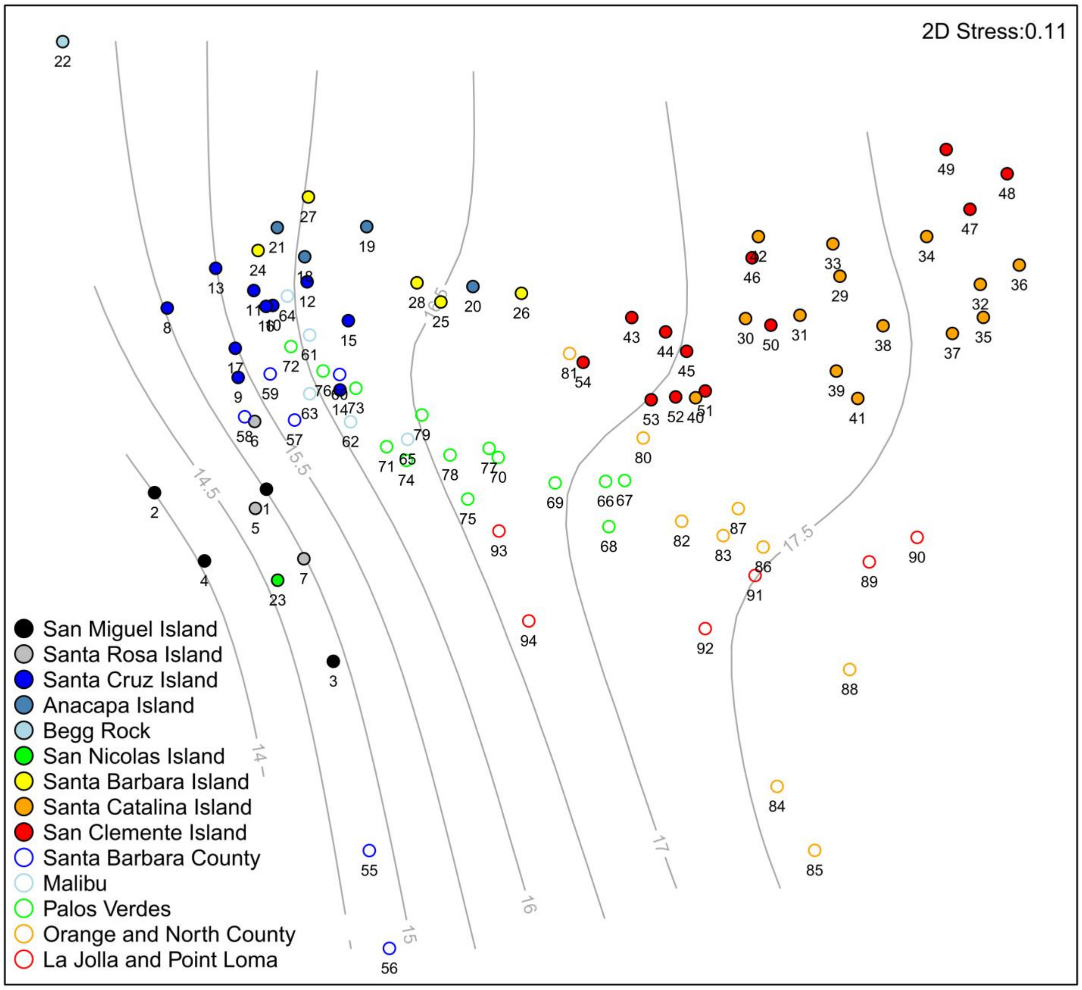


Figure 8. Non-metric multidimensional ordination plot of benthic macroinvertebrate (swath data) communities using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each of the 94 sites across the 14 Geographic Areas overlaid on a fitted SST surface (grey contour lines; °C). Sites are numbered according to Figure 3.

Benthic Macroinvertebrates

Benthic macroinvertebrate communities also were differentiated across the SCSR (Figure 8**,** Appendix B. Table B.3). Geographic Areas in the Santa Barbara Channel area (San Miguel Island, Santa Rosa Island, Anacapa Island and the Santa Barbara County mainland) showed similarities in invertebrate communities and the northern sites were different than the southern part of the SCSR, again corresponding to differences in SST. Interestingly, Geographic Areas within the southern portion of the SCSR were all significantly different from one another. Begg Rock also exhibited clear separation from the other communities, with the benthic macroinvertebrate community at this unique and isolated pinnacle reef being dominated by anemones (*Metridium spp*. and *Anthopleura sola*).

Kelps

Kelp communities showed the least differentiation among Geographic Areas (Figure 9) with no clear relationship to SST (the pattern was ambiguous and therefore the contour lines were not included in Figure 9). While some Geographic Areas were significantly different than others, no clear patterns emerge and the strengths of the relationships were lower on average than for invertebrates and fishes (Appendix B. Table B.4.1). Also, note that Begg Rock is not included in Figure 9 as no kelps were observed at that site during sampling (Figure 5), further illustrating the uniqueness of the pinnacle reef. Results were similar when this analysis was repeated using Giant Kelp (*Macrocystis pyrifera*) stipe density (stipes per 100 m^2) instead of the density of Giant Kelp individuals (Appendix B. Figure B.3, Table B.4.2).

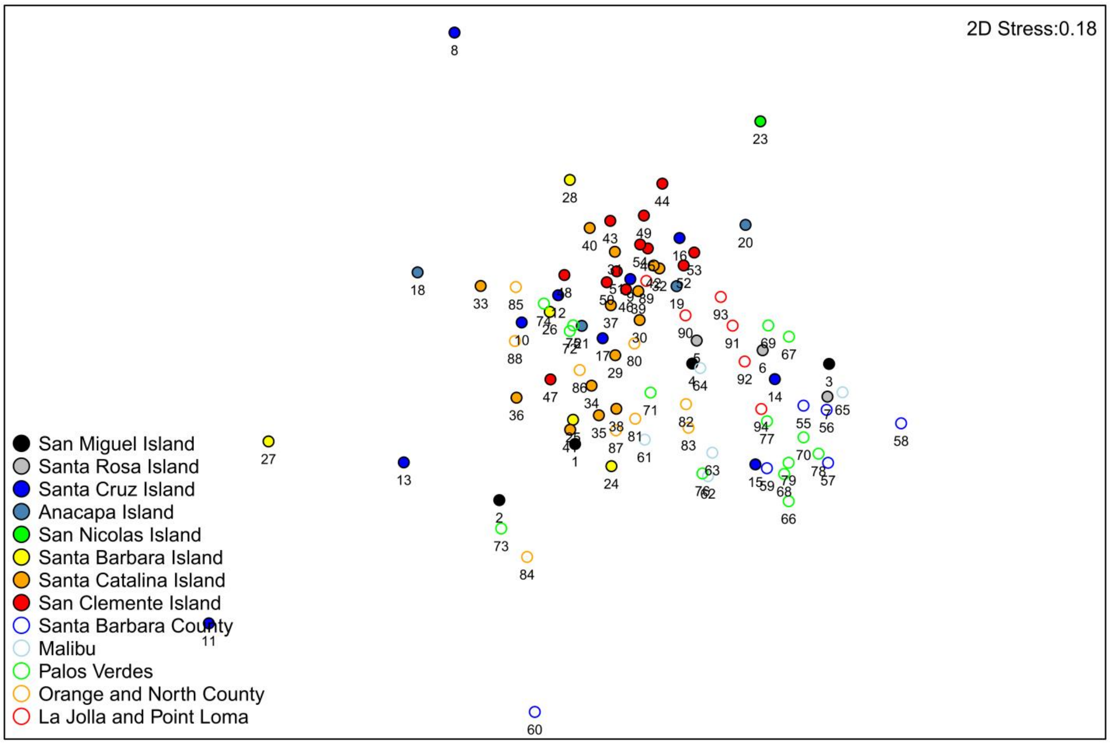


Figure 9. Non-metric multidimensional ordination plot of kelp (swath data) communities using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each of the 94 sites across the 14 Geographic Areas. Sites are numbered according to Figure 3.

Benthic Cover

In terms of percent cover of benthic organisms and other abiotic cover types, the strength of differentiation among Geographic Areas was moderate (Figure 10). While there was clear separation between northern and southern Geographic Areas, sites within Geographic Areas among the Northern Channel Islands tended to overlap more with each other, with more differentiation (pairwise significant differences) among Geographic Areas in the southern part of the SCSR (Appendix B, Table B.5).

In southern California, the extent of geographic variation in community structure for various taxonomic groups tends to be strongest (i.e., fine-scale structure) for fishes, moderate for invertebrates and benthic cover of sessile invertebrates and algae and weakest (i.e., lack of structure) for kelps. These relative degrees of geographic variation in assemblages observed in the SCSR (fishes>inverts>kelps) are counter to that observed in the Central Coast Study Region (kelps>fishes>inverts) and the North Central Coast Study Region (kelps>inverts>fishes) (Caselle and Carr, unpublished data, Central Coast and North Central Coast monitoring reports). Kelps and macroalgae (primarily Laminariales) are known to vary strongly from year to year in response to storms and ocean swell and the greater geographic variation in exposure to ocean swell that underpins geographic variation in the kelp assemblages is not as strong as in the SCSR compared to the central and north central coasts of California. In contrast, the greater geographic variation in water temperature in the SCSR, to which fish assemblages are known to respond strongly to (e.g., Holbrook et al. 1997; Hamilton et al. 2010), are negligible in the central and north central coasts. Finally, fish and invertebrate communities are less ephemeral, storing the effects of strong recruitment periods for years to decades.

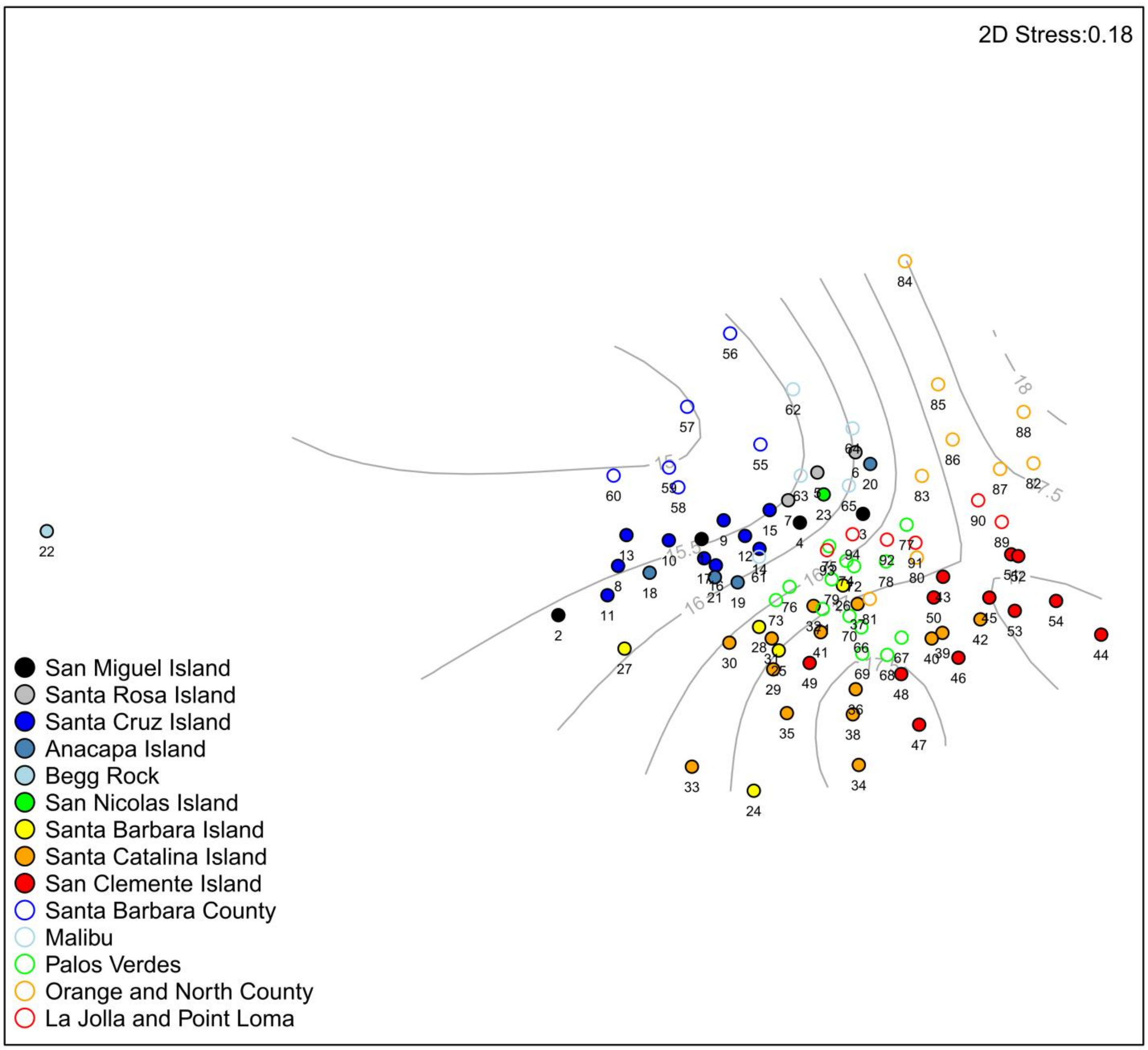


Figure 10. Non-metric multidimensional ordination plot of benthic cover (UPC data) communities using Bray-Curtis similarity based on the arcsine square root transformed cover category percent cover averaged across 2011 and 2012 for each of the 94 sites across the 14 Geographic Areas overlaid on a fitted SST surface (grey contour lines; °C). Sites are numbered according to Figure 3.

Focal Species

We present the patterns across the SCSR for individual focal species. These species include those from the MLPA SCSR baseline monitoring plan (Vital Signs) as well as additional species of interest and/or high abundance in the region. Example species demonstrating the range of geographic patterns observed are presented here; all other species are shown in the Appendices. Analyses of individual species patterns will inform discussion of indicators for MPA assessment in future monitoring programs, as well as guide analyses of existing and future data. For example, while particular species might be amenable to easy identification by citizen science groups (one criteria for a good indicator species), their spatial distribution may limit the ability of such groups to survey them effectively (e.g., if such species only occur in particular sites). Multiple criteria such as this are considered further in the "Candidate Indicator Species Evaluation" section below.

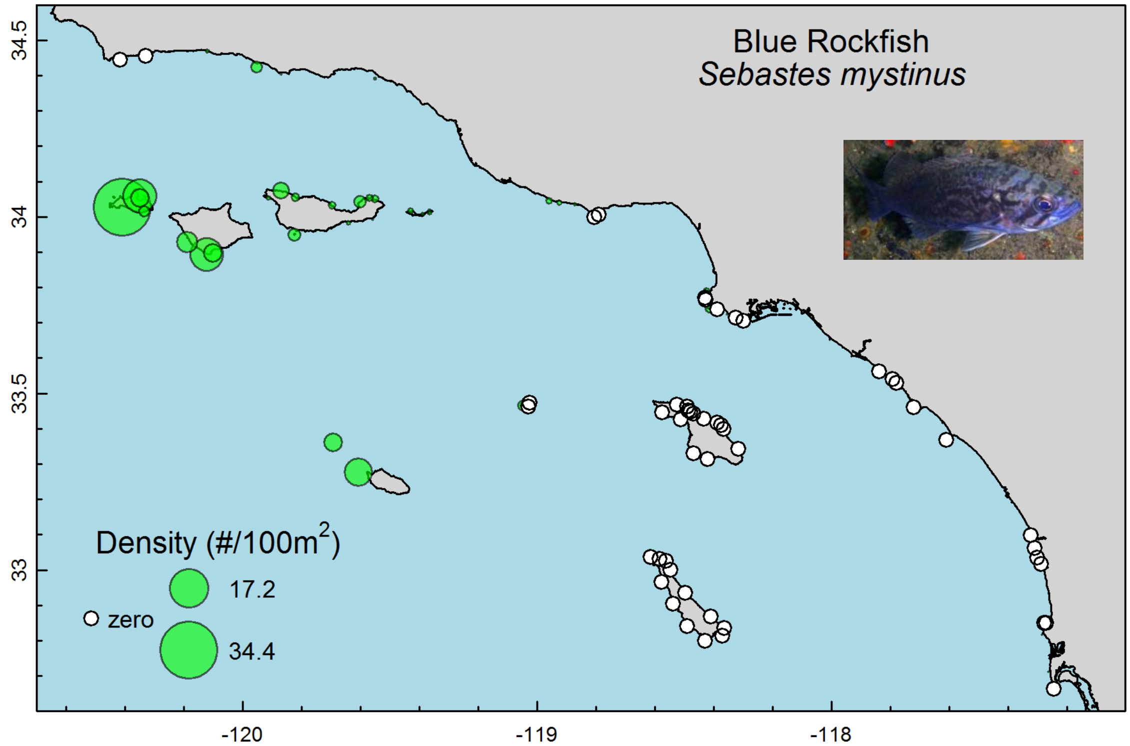
Fish Biomass and Density

Individual fish species tend to show one of three geographic patterns of distribution in the Southern California Bight. These are:

1) Northern – These species occur primarily in the colder waters of western part of the Santa Barbara Channel. They include most of the rockfishes [as exemplified by Blue Rockfish (*Sebastes mystinus*) (Figure 11)], as well as Cabezon (*Scorpaenichthys marmoratus*) (see Appendix C, Figure C.1-C.23).

2) Southern – These species are distributed across the Southern California Bight except for locations in the western part of SBC. Hence, there can be some overlap between 'northern' and 'southern' species distributions at Santa Cruz and Anacapa (eastern part of the SBC and NCI). These species include members of tropical families such as Garibaldi (*Hypsypops rubicundus*) (Figure 12), Opaleye (*Girella nigricans*) and Kelp Bass (*Paralabrax clathratus*) (see Appendix C, Figure C.1-C.23).

3) Widespread – A large number of species are widely distributed throughout the SCSR, although their density and biomass is rarely equal throughout the region. These include California Sheephead (*Semicossyphus pulcher*) (Figure 13), Blacksmith (*Chromis punctipinnis*), Señorita (*Oxyjulis californica*), Black Perch (*Embiotoca jacksoni*) and Kelp Perch (*Brachyistius frenatus*) (see Appendix C, Figure C.1-C.23).



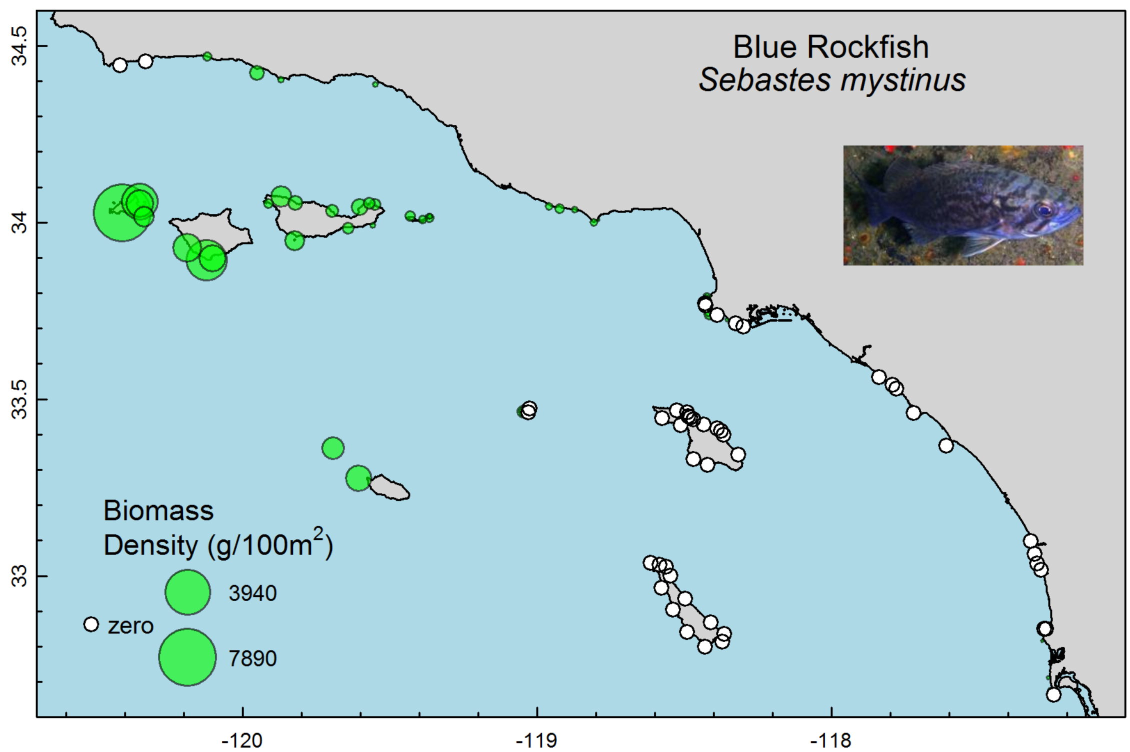


Figure 11. Geographic distribution of *Sebastes mystinus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

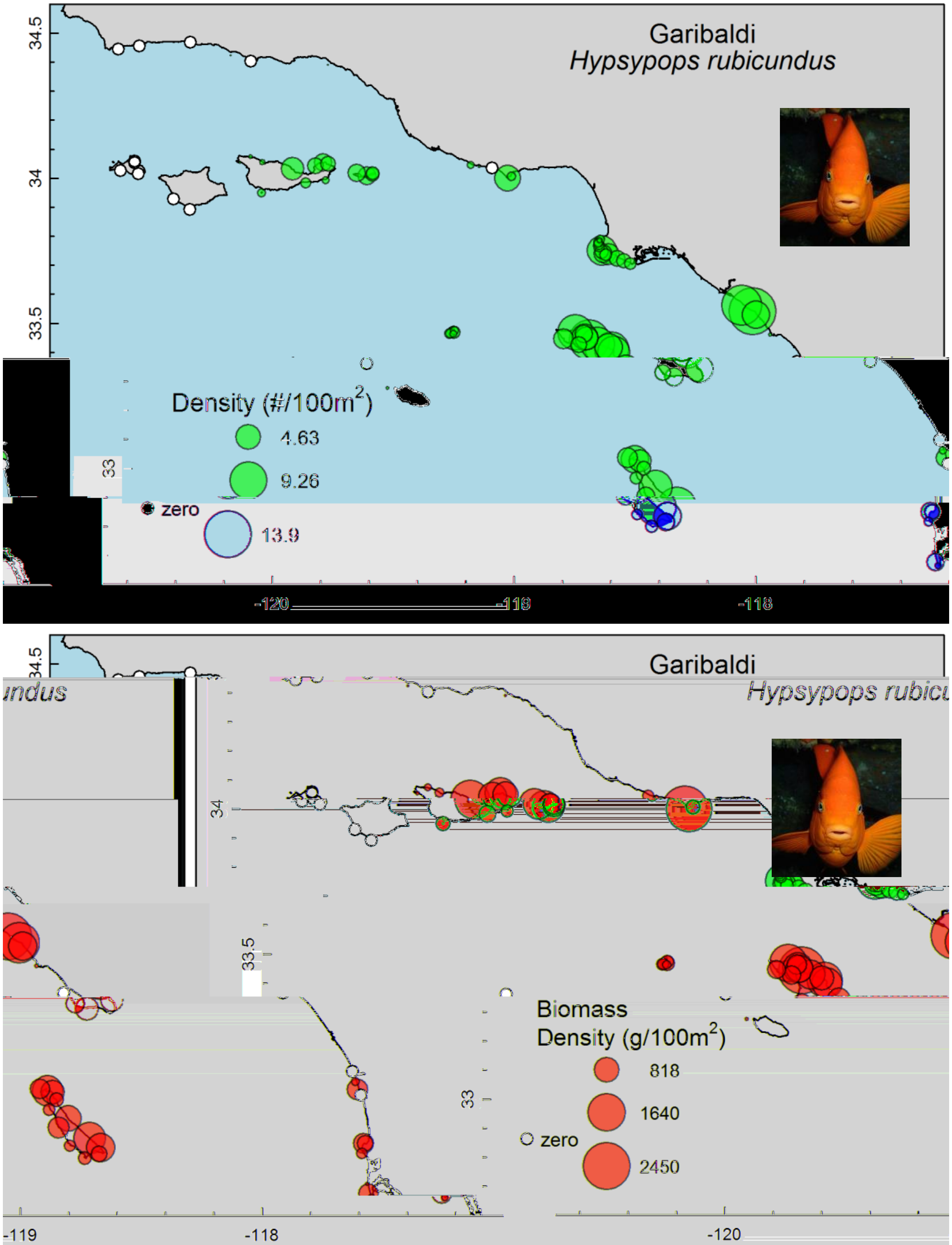


Figure 12. Geographic distribution of *Hypsypops rubicundus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

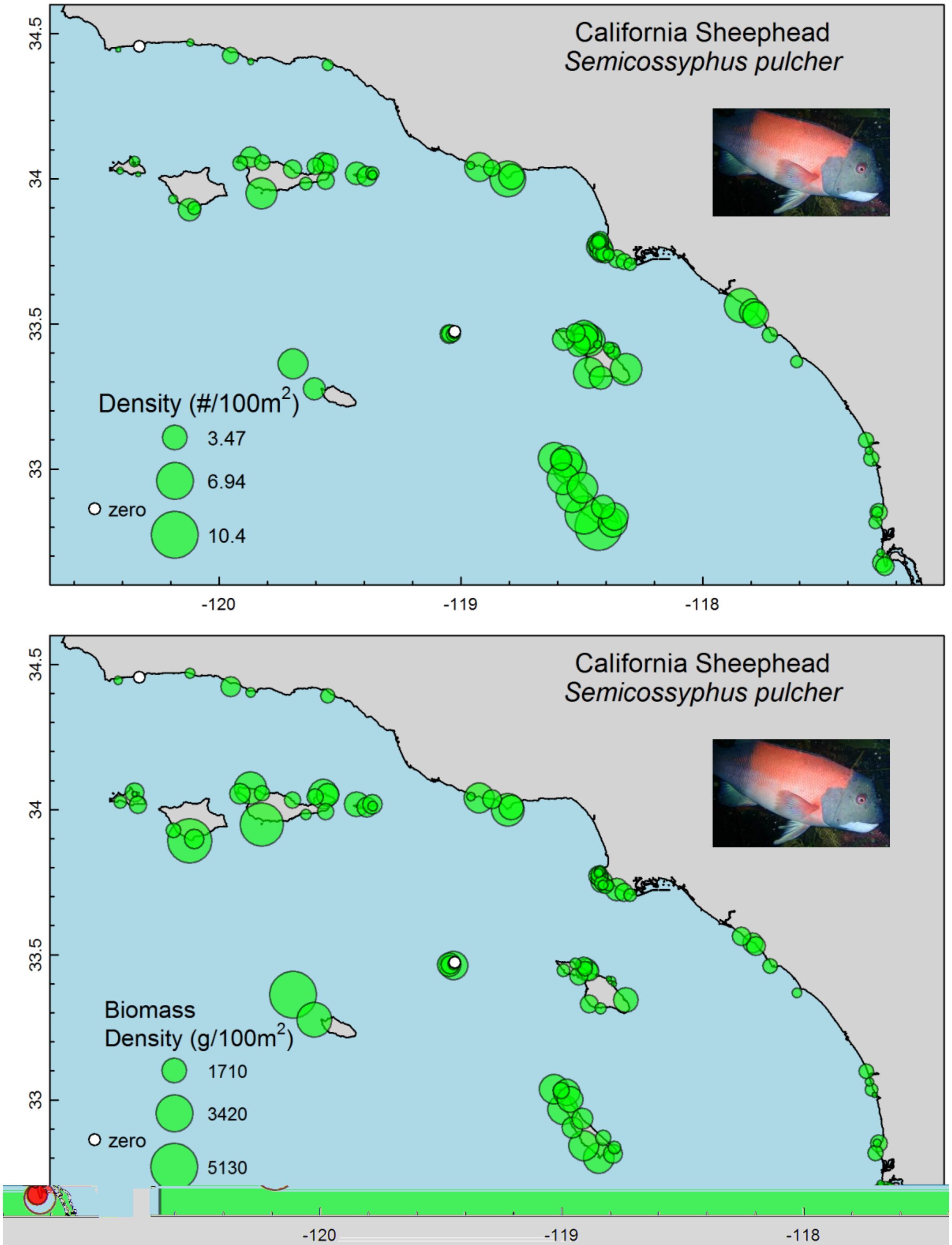


Figure 13. Geographic distribution of *Semicossyphus pulcher* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

Invertebrate Density

Invertebrate species can also be classified into northern, southern and widespread groups although the patterns are not as clear, in general, as for the fishes.

(1) Northern – Northern invertebrate species do not show the exactly the same patterns as Northern fish species which were limited to the western part of the NCI and SBC. 'Northern' invertebrates tend to occur throughout the NCI and SBC and also occur at the Palos Verdes peninsula Geographic Area before densities tend to reduce dramatically. Northern species are primarily echinoderms but also include Red Abalone (*Haliotis rufescens*) and the Stalked Tunicate (*Styela montereyensis*). The echinoderms include both Red Urchin (*Strongylocentrotus franciscanus*) and Purple Urchin (*S. purpuratus*) (Figure 14), as well as Sunflower Star (*Pycnopodia helianthoides*), Bat Star (*Patiria miniata*) and Short-spined Star (*Pisaster brevispinus*) (see Appendix C, Figure C.25-C.40).

(2) Southern – Southern species are characterized as occurring primarily south of Palos Verdes, and many of these species reach highest densities on Santa Catalina and San Clemente Islands. Examples include the important fishery species California Spiny Lobster (*Panularis interruptus*) (Figure 15), both Pink and Green Abalone (*Haliotis corrugata* and *H. fulgens*) as well as the Coronado Urchin (*Centrostephanus coronatus*) and the California Golden Gorgonian (*Muricea californica*) (see Appendix C, Figure C.25-C.40).

(3) Widespread – Additional species are distributed more widely throughout the SCSR and include Kellet's Whelk (*Kelletia kelletii*) (Figure 16), Warty Sea Cucumber (*Parastichopus parvimensis*), Giant Keyhole Limpet (*Megathura crenulata*), and Giant-spined Star (*Pisaster giganteus*) (see Appendix C, Figure C.25-C.40).

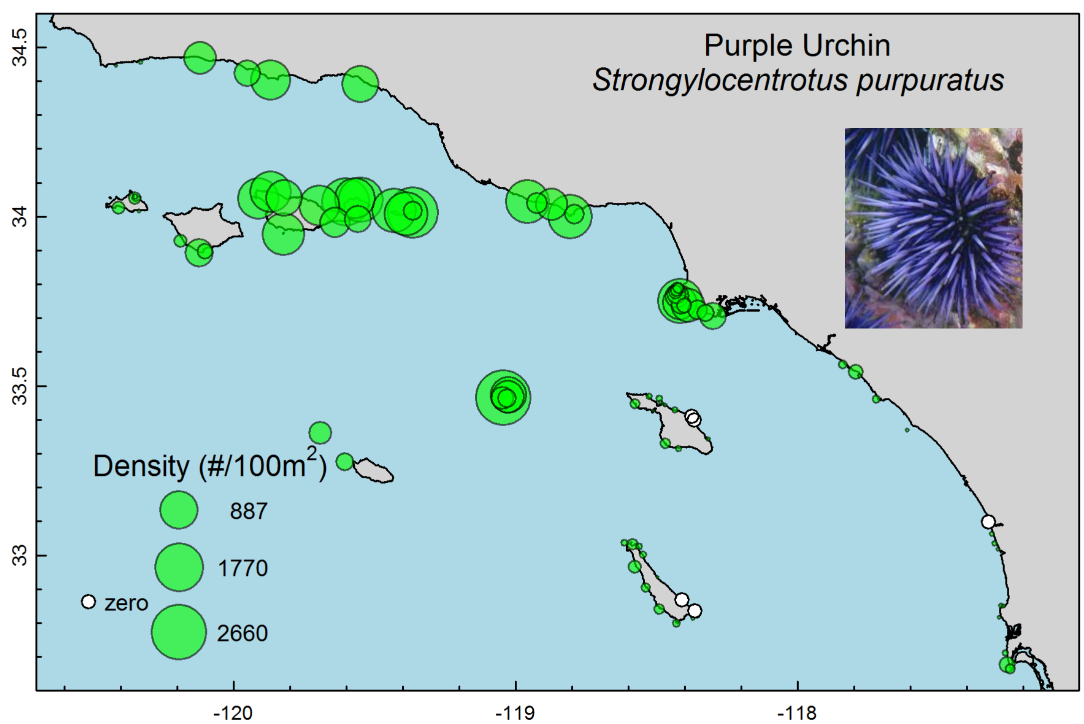


Figure 14. Geographic distribution of *Strongylocentrotus purpuratus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

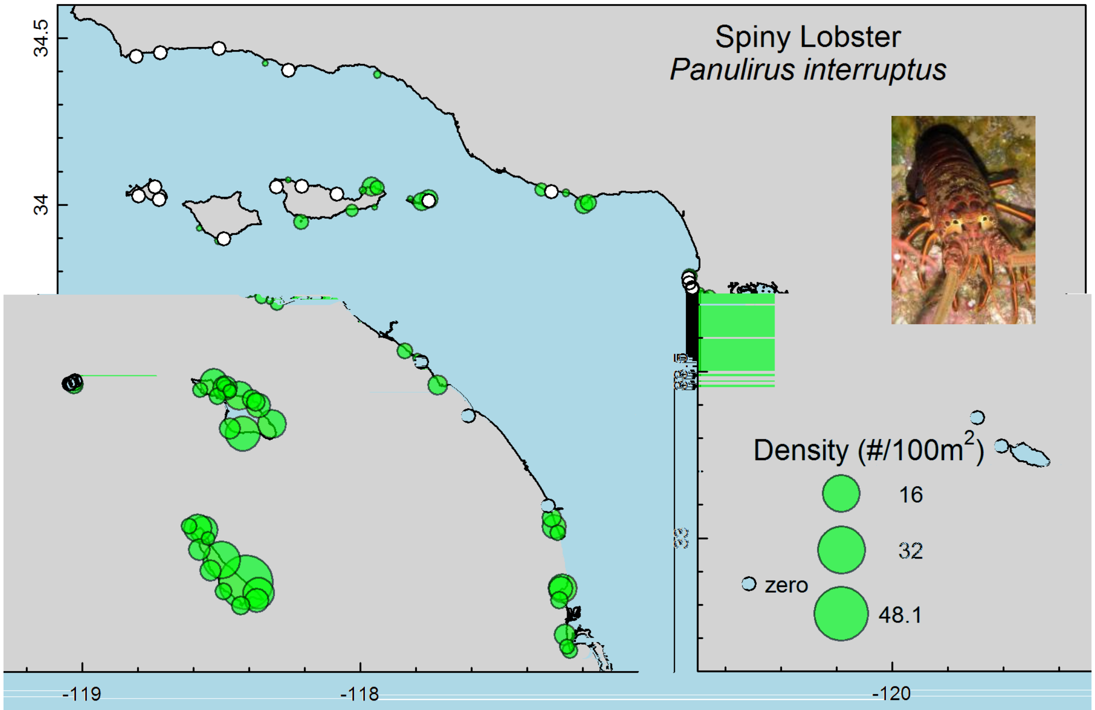


Figure 15. Geographic distribution of *Panulirus interruptus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

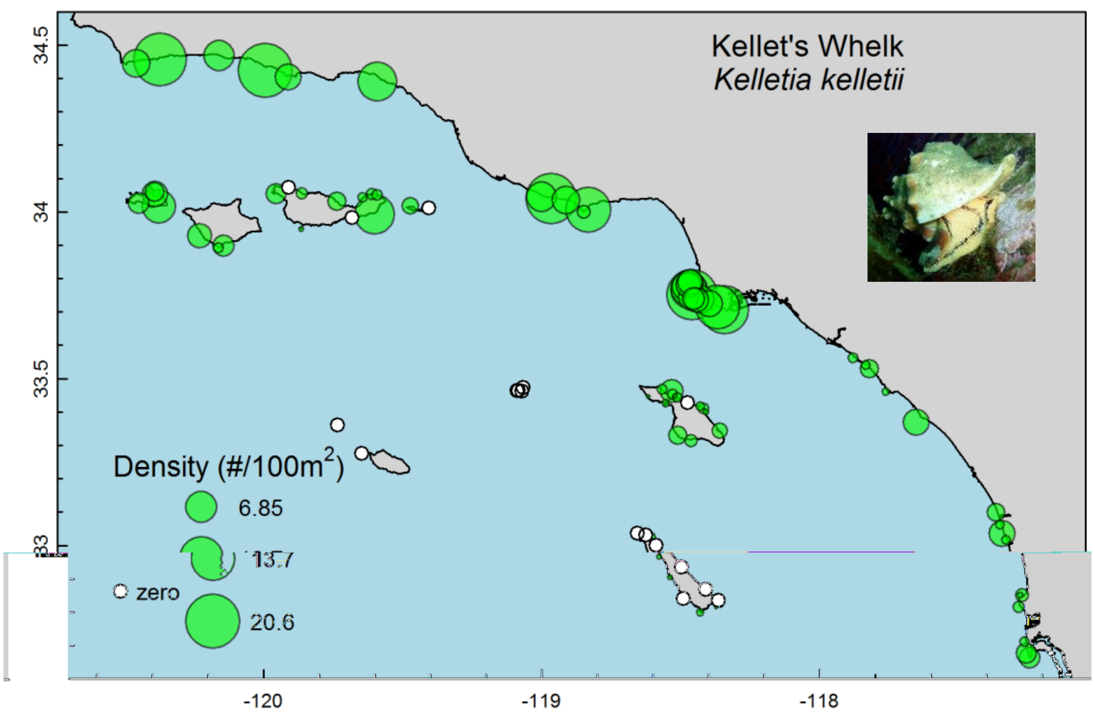


Figure 16. Geographic distribution of *Kelletia kelletii* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

Ecosystem Trends

In this section we summarize several characteristics of large-scale environmental conditions that are likely to influence the kelp forest data collected in the SCSR during the relatively short time of the baseline period, as well as in future monitoring. We follow this with analyses of other attributes of the system (data gathered by us and others) that we feel may be important to interpretations of future changes in MPAs in the SCSR. These analyses also provide additional context for future users of the MLPA monitoring data and we suggest that the results be considered in long-term monitoring plans.

Setting the Baseline in Context: Large-Scale Environmental Conditions

Pacific Decadal Oscillation (PDO) and El Nino/Southern Oscillation (ENSO) are patterns of Pacific climate that influence productivity and sea temperature among other variables. While the two climate oscillations have similar spatial climate fingerprints, they have very different behavior in time. PDO regimes tend to persist for 20 to 30 years while ENSO events are shorter, averaging 6-18 months. Both cyclic oscillations have been shown to influence a large number of marine community attributes in southern California including species diversity and abundance, community structure and recruitment (e.g., Tegner and Dayton 1991; Stephens Jr et al. 1994; Holbrook et al. 1997; Stephens et al. 2006). PDO and ENSO are both well represented by large-scale multivariate indices that are commonly used and readily available (PDO index: http://jisao.washington.edu/pdo/; Multivariate ENSO index (MEI): http://www.esrl.noaa.gov/psd/enso/mei/).

Field data for this baseline survey were collected in 2011 and 2012 throughout southern California. The PDO index (Figure 17) has been primarily negative (indicating a cold water regime) since approximately 2000. 2011 and 2012 were both years of strongly negative PDO. On the other hand, the SCSR has experienced ENSO neutral conditions throughout our survey period (Figure 17). Negative values of the MEI represent the cold ENSO phase (La Niña), while positive MEI values represent the warm ENSO phase (El Niño). The last large El Niño occurred in 1997-1998 and was followed by a La Niña lasting from 1999-2001. Since that time, there have been no large MEI anomalies.

The climate cycle has important consequences for this baseline survey and future MPA assessments. The fish, invertebrate and algal communities in southern California are highly dynamic and have been shown to shift towards cold-water species/families following long periods of low sea temperatures and consequent higher productivity (Holbrook et al. 1997). When conditions change (as they appeared to do in 2014 with very warm water temperatures and a potential mild to moderate El Niño predicted), these communities can shift towards those dominated by warm water groups. In dynamic temperate systems, it will be important to account for the effects of long- and short-term climate oscillations when assessing MPAs or other management actions.

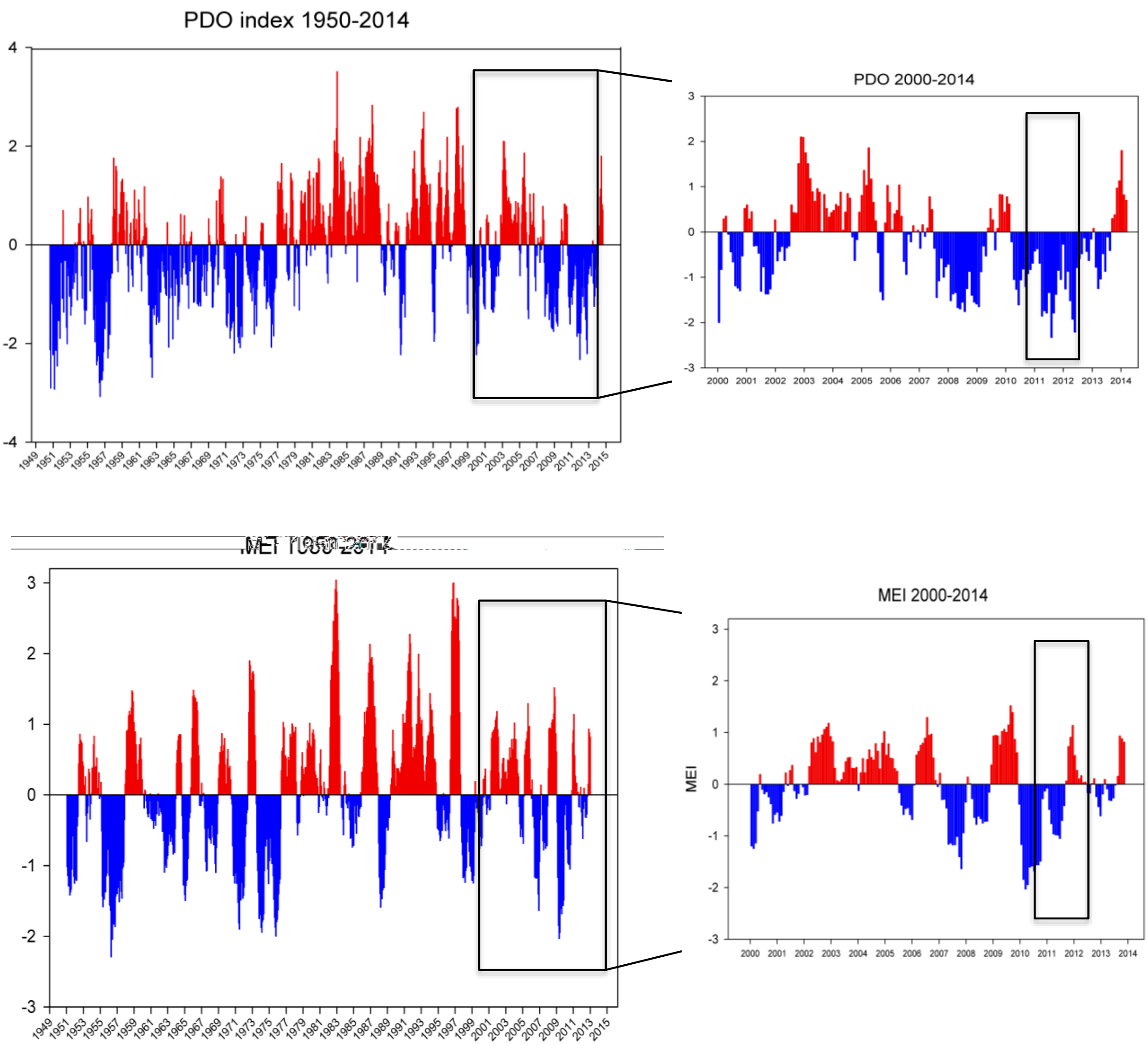


Figure 17. (top) Pacific decadal oscillation index from the period 1950 through 2014. Values greater than 0 represent warm conditions and are shown in red. Negative values indicate cold conditions and are shown in blue. The inset shows detail for the period the period 2000-2014 and the box encloses 2001-2012 – the baseline field sample years. (bottom) Multivariate ENSO Index (MEI) from the period 1950 through 2014. Values greater than 0 represent positive ENSO conditions and are shown in red. Negative values are shown in blue. The inset shows detail for the period 2000-2014 and the box encloses 2001-2012 – the baseline field sample years.

Setting the Baseline in Context: Dynamics of Recruitment

Most marine organisms have a two-part life cycle including a pelagic larval phase and a settled, demersal or benthic phase. The transition of pelagic larvae to a reef based population is called recruitment and is important to assessing changes in population and communities over time and in relation to different management actions including MPAs (White et al. 2013; Grorud-Colvert et al. in prep). In particular, recruitment rates are important to determining the response rates of MPAs in that populations can only change in MPAs via reduced mortality or changes in input. PISCO has been monitoring recruitment of fishes to artificial substrates in the Santa Barbara channel region since 2000.

Our previous work has shown three 'synoptic states' that describe differences in recruitment rates of various species groups. Generally, we observe either good years for rockfish (and associated cold water species), good years for Kelp Bass (and associated warm-water species) or poor years for all. The pattern is related to the strength of spring upwelling (Caselle et al. 2010b); stronger upwelling results in strong rockfish settlement while weak upwelling is correlated with strong kelp bass recruitment. The two years of baseline data collection on rocky reefs in the SCSR (2011 and 2012) were characterized by interannual variability in the strength of settlement. 2011 was a good year for rockfish and a moderate/weak year for Kelp Bass, while 2012 was a strong year for kelp bass and a weak/moderate year for rockfish (although not a complete year class failure) (Figure 18). Patterns of recruitment leading up to MPA implementation will potentially limit the scope of change. For example, there was an almost complete year class failure for kelp bass from 2007-2010, which will limit the size of the kelp bass populations in and out of MPAs for years following. It will be important to separate the effects of variable recruitment from fishing and other anthropogenic actions when assessing MPA performance and we suggest that future monitoring include measures of recruitment.

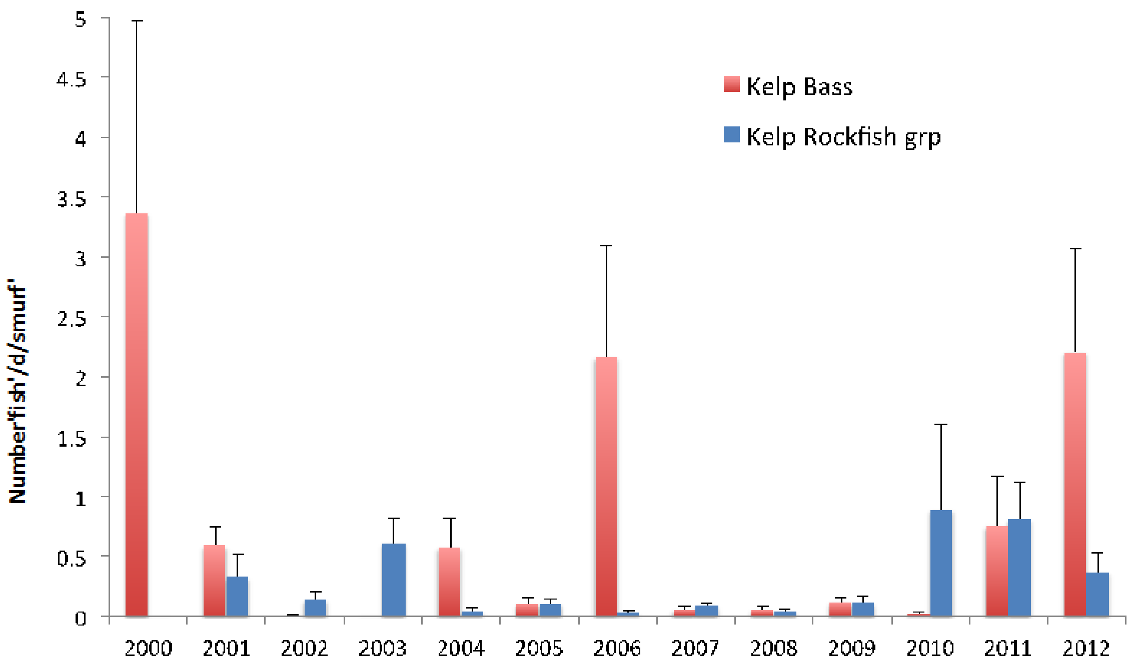


Figure 18. Interannual patterns in recruitment of Kelp Bass (*Paralabrax clathratus*) – a warm water, sub-tropical species (red bars) and the kelp rockfish complex (*Sebastes atrovirens*, *S. caurinus*, and *S. carnatus*) – cold-water, temperate group (blue bars).

Setting the Baseline in Context: Water Quality in the SCSR

During the MLPA process, much of the mainland of the SCSR was classified as having impaired water quality caused by a variety of point and non-point source inputs (California MLPA Initiative 2009). As a parallel study to this baseline assessment, two primary sources of anthropogenic pollutants, treated wastewater, released by publicly owned treatment works (POTWs) through ocean outfalls, and freshwater run-off contained in river plumes, were modeled for the mainland (Figure 19) by our collaborators at the Southern California Coastal Water Research Project as part of the Bight '13 project. They developed a geospatial tool in ArcGIS to calculate a Water Quality Index (WQI) across much of the

SCSR. The WQI quantifies long-term exposure to potentially harmful pollutants emanating from these two sources. As a general overview, there is quite a bit of coast wide variation for these inputs, but the general pattern is a greater input and potential impact by the larger metropolitan areas (e.g., Los Angeles, Newport and San Diego) (Schaffner et al. in review). While the effects of these inputs on nearshore rocky reefs is a dynamic area of study, it has been established that sedimentation and associated processes (turbidity, scour and reef burial) are a significant deleterious factor (Pondella et al. 2012). The WQI has some significant data gaps; it currently incorporates only major point source pollution, large POTWs and rivers. Runoff and point source pollution from smaller plumes, such as storm drains or small POTWs are not included. The WQI will be incorporated into ongoing studies to examine relative risks posed to marine habitats by pollutants and fishing pressure, and subsequent products will provide additional data layers for future evaluations of MPA impacts in the SCSR.

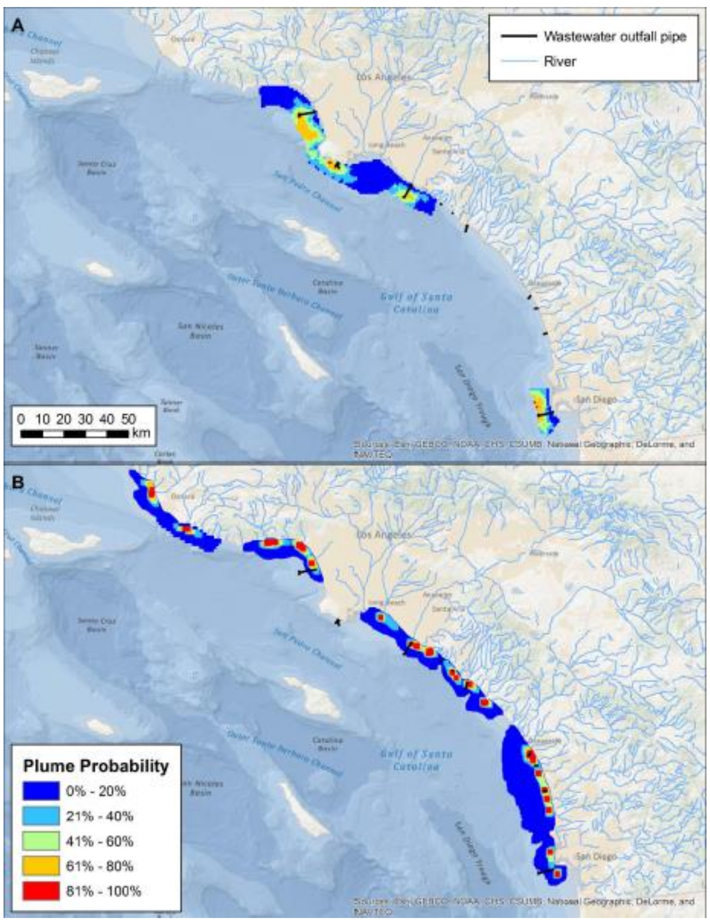


Figure 19. POTW Plume probability (A) and river plume probability (B) for the mainland of the SCB (Schaffner et al. in review).

Setting the Baseline in Context: Fishing Pressure in the SCSR

The SCSR is an area under intensive fishery pressure. Commercial fishing on rocky reefs in southern California has accounted for over $366 million US dollars' worth of harvested marine organisms, almost 10% of the total $4 billion dollars for the entire state of California (Perry et al. 2010) over the 30-year time period that we assessed (1980-2009) in this study. Additionally, southern California hosts the largest recreational fishing market for the west coast of the contiguous US, accounting for almost 50% of the total harvest in this region at times (Gautam 1996). Using 29 years of landings records collected by the California Department of Fish and Wildlife (CDFW), we quantified a multi-species spatial fishing pressure index to evaluate spatial distributions of commercial and recreational Commercial Passenger Fishing Vessel (CPFV) fisheries across shallow rocky reef habitat in the SCSR. Fishing pressure is not uniformly distributed over this region by taxa, method nor industry (Zellmer et al. in review). The commercial fishery in this ecosystem is focused on extractions of invertebrates (e.g., Red Urchin, Rock Crab, California Spiny Lobster) while the recreational CPFV fishery extracts primarily finfish (e.g., Barred Sand Bass, Kelp Bass, California Scorpionfish). With the exception of Red Urchin, the largest commercial fishery in this habitat, there was no significant difference in the yearly extraction rates from shallow rocky reefs in the SCSR between the commercial fishery (866.53 MT/yr) and recreational CPFV fishery (826.30 MT/yr). Further details on the resource extraction by MPA and Fishing Block are summarized in Appendix H, Table H.1-H.2. These industries do however exhibit significant spatial partitioning, with the commercial fishers preferentially targeting the islands, while the recreational fishery is focused on the mainland (Zellmer et al. in review). Within those two general patterns, extraction among these reef systems varies significantly (Figure 20). Commercial fishing is correlated with the spatial extent of individual reefs, while recreational fishing is not. Certain areas of the coastline (Santa Monica Bay, Newport, Anacapa and Santa Catalina Islands) have particularly high pressure likely due to access (i.e., distance to port) in part caused by the recreational fishery continually targeting reefs systems that are close to port. This significant spatial variability and pressure adds an additional context for understanding this dynamic region. In future analyses of the impacts related to removing fishing effects from within the MPAs, these data may provide explanatory power with respect to why trajectories of change vary across different MPAs. Greater effects would be expected for species that are more heavily exploited in the local area (Lester et al. 2009; Hamilton et al. 2010). These indices can also be updated over time as more recent CDFW fishing block data becomes available. This study can be expanded to evaluate spatial patterns of harvest across the entire State in a similar fashion, making this spatial fishing pressure layer available for the other study regions.

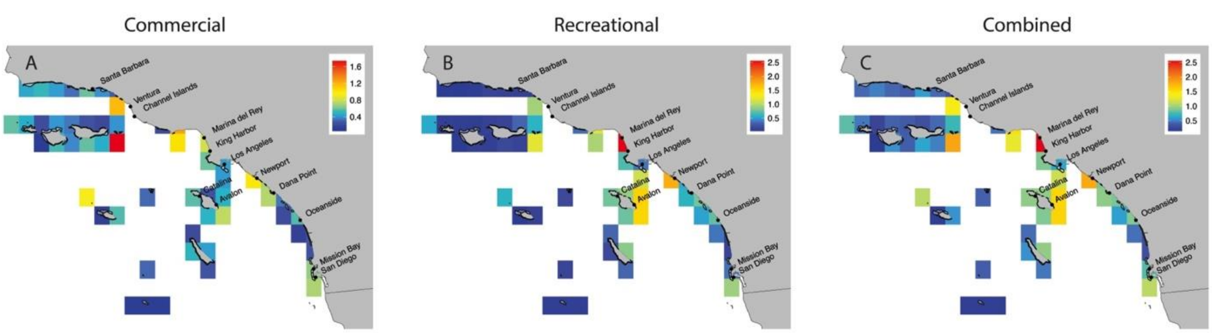


Figure 20. Spatial distribution of the fishing pressure index for A) commercial, B) recreational, and C) the combined fisheries for the multi-species dataset. The fishing pressure index was calculated as $\log_{10}$+1 tons per year harvest rates per amount of reef area in each block (MT/yr/km^2). The colors indicate areas with high (red) versus low (blue) fishing harvest rates per km^2 reef area. Only data for CDFW fishing blocks that contain shallow (<30m depth) rocky reefs are shown (Zellmer et al. in review).

Historical and Baseline Surveys of Focal Species

Using historical data collected during the two SCSR-wide surveys of rocky reefs (CRANE in 2004, Bight '08 in 2008, see methods) combined with Baseline surveys (in 2011 and 2012), we present mean biomass for fishes and density for invertebrates over time (Appendix D, Figure D.1-D.44) for the 14 Geographic Areas we defined for the SCSR (see Baseline Characterization community analyses). Not surprisingly, there are no consistent trends over time (i.e., increases or decreases) for any single species across Geographic Areas. The patterns are highly variable and even Geographic Areas that are located near each other can show very different temporal patterns. For example, total fish biomass increased in some Geographic Areas and decreased in others (Figure 21). A common and abundant fish species in the SCSR, Kelp Bass (*Paralabrax clathratus*), shows no consistent patterns across regions although there is a suggestion that biomass of this species was higher in the Baseline period at the islands where the species is abundant (i.e., Santa Cruz Island, Anacapa Island, Catalina Island and San Clemente Island) (Figure 22). Invertebrate density is similarly variable. For example, Red Urchin density increased over time at Santa Cruz Island but decreased at neighboring Anacapa Island (Figure 23). The lack of pattern in this historical dataset is not wholly surprising given that the survey consists of 4 years, in two instances separated in time by 3-4 years. As shown above, environmental conditions can change dramatically in that period. For example, 2004 was in the middle of a five-year warm period of the PDO cycle, while 2008 was the first of several cold years of that cycle. Further, the dataset is highly unbalanced, in most cases consisting of a variable number and location of sites among the historical data sets relative to the Baseline data, which precludes some statistical analyses (e.g., time series analysis). This is an inevitable consequence of multiple groups forming loose collaborations to conduct monitoring. However, these data provide a useful baseline against which future monitoring can be measured, but we caution that with large intervals between samples longer time series will be necessary to detect meaningful temporal trends (see Historical Trends: Channel Islands Marine Reserves section below).

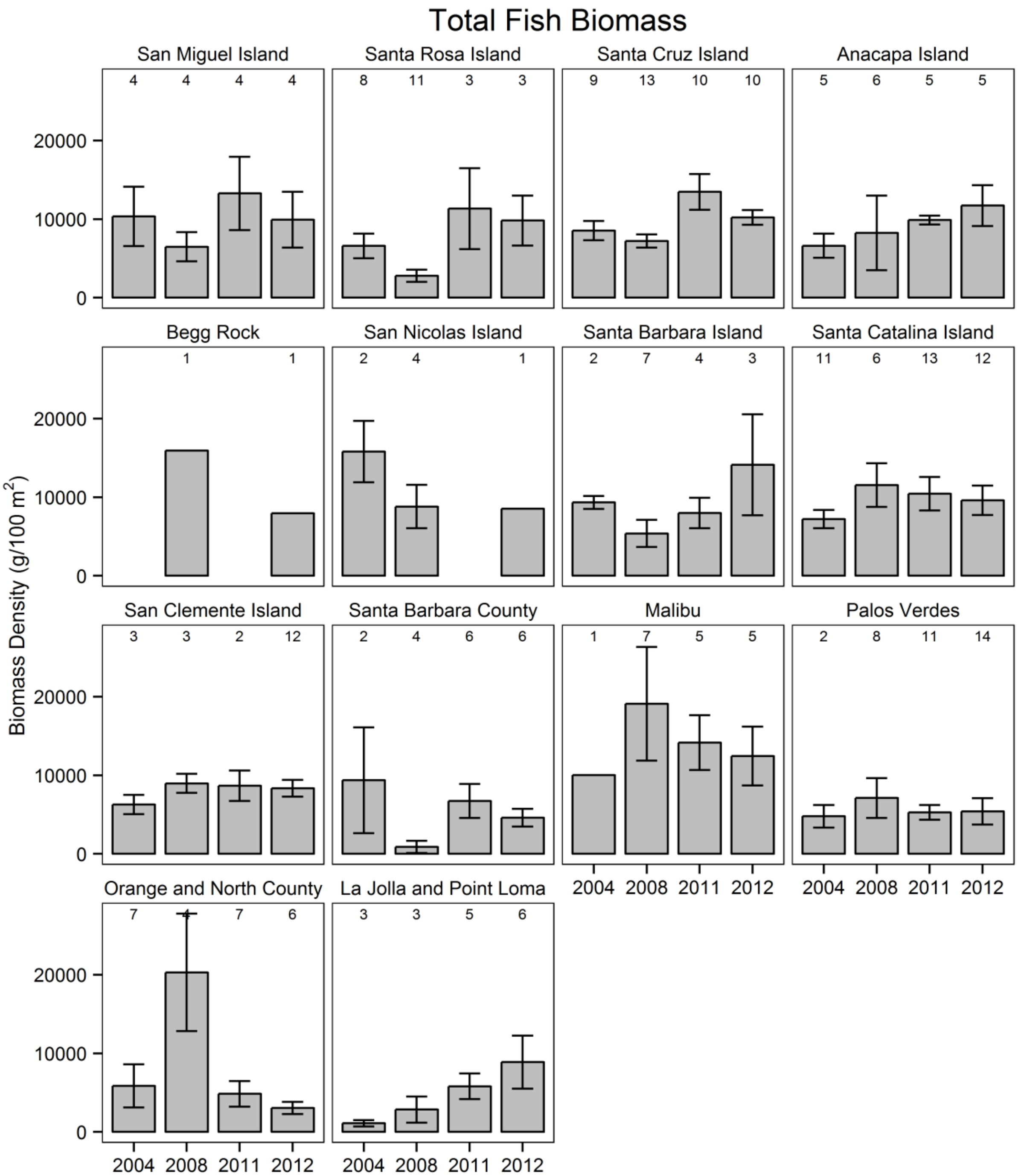


Figure 21. Total fish biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

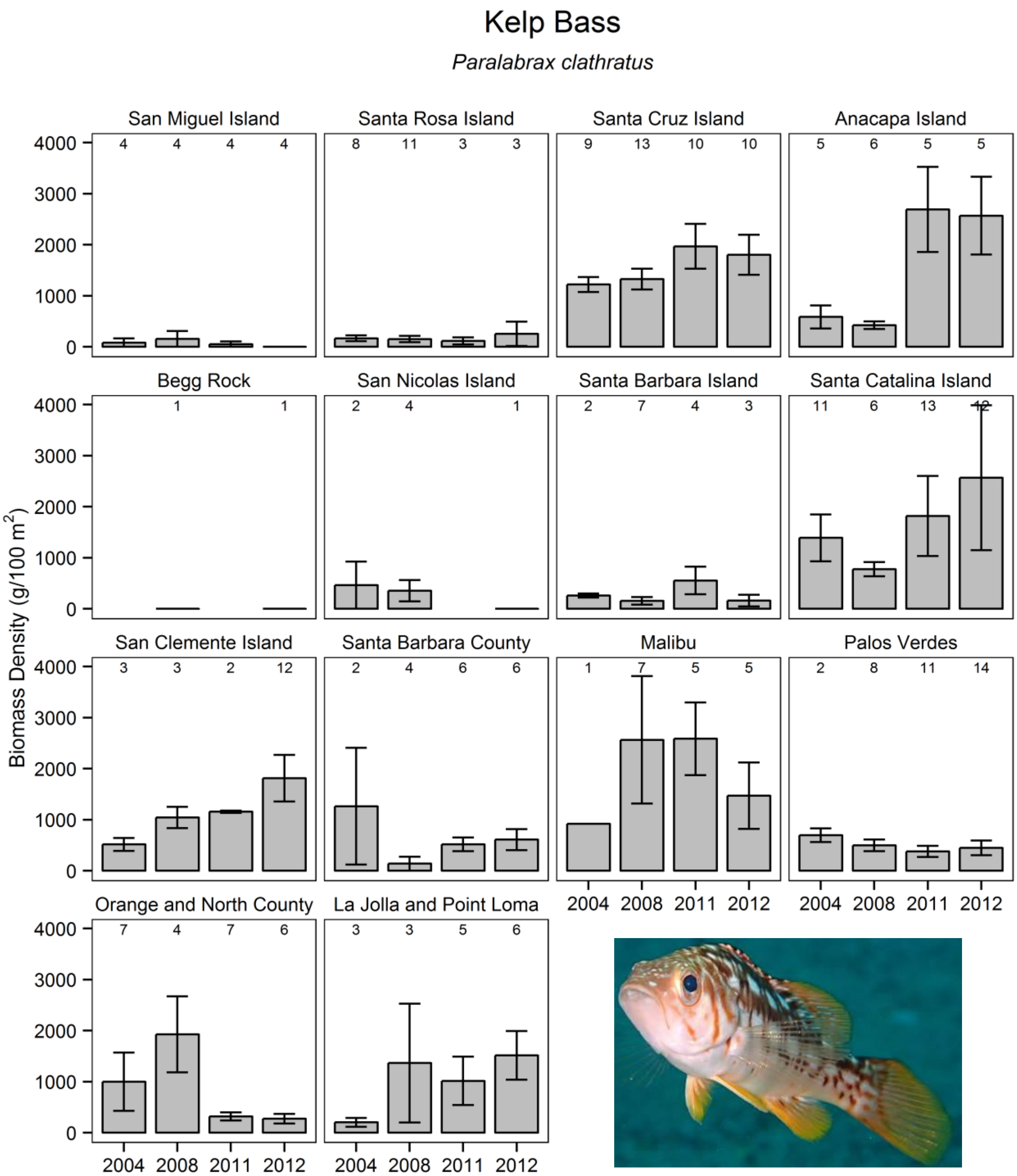


Figure 22. *Paralabrax clathratus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

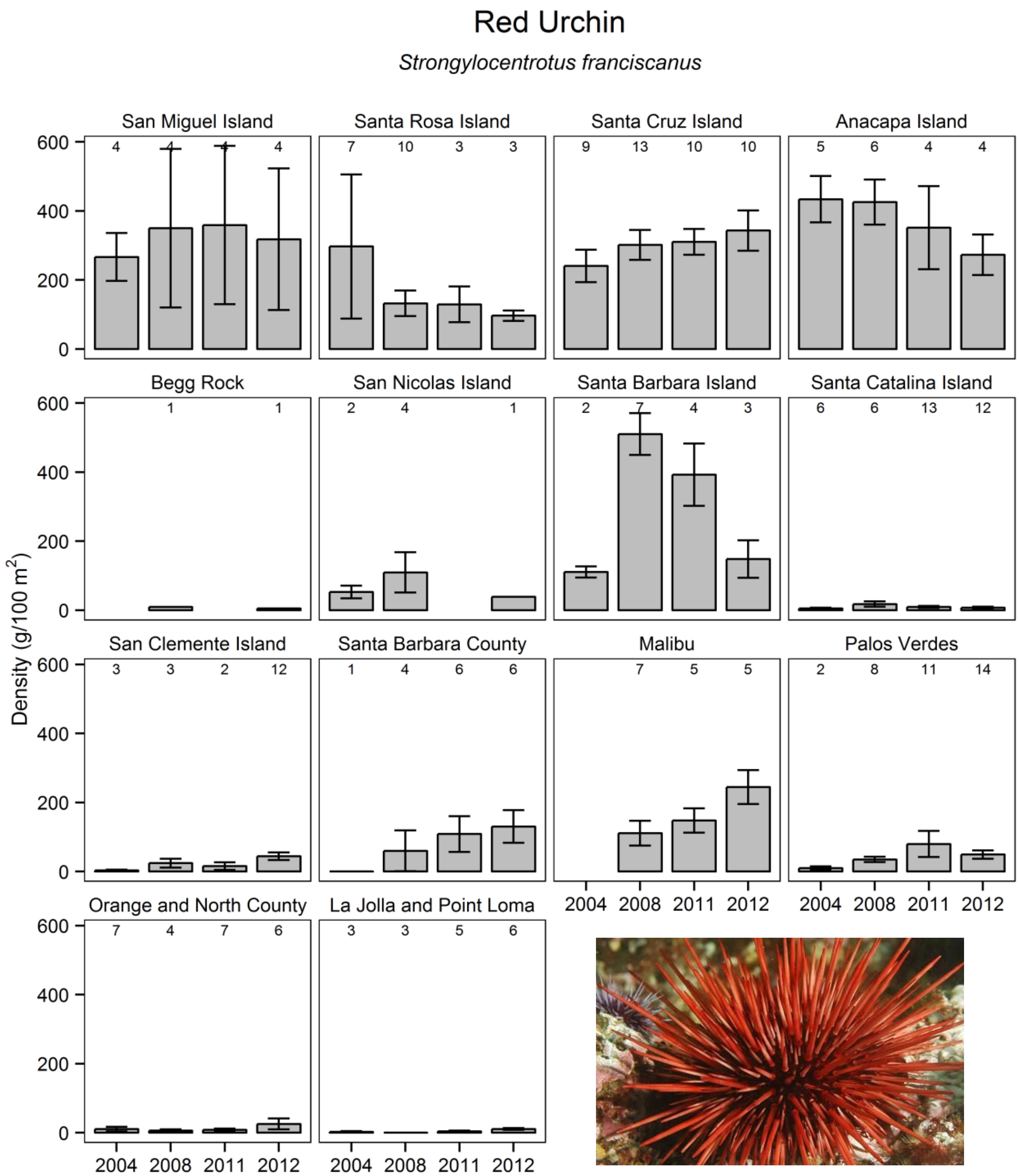


Figure 23. *Strongylocentrotus franciscanus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

MPA and Reference Areas

MPA Versus Reference Sites: Habitat Characterization

A primary objective of this study was to provide a quantitative baseline against which future monitoring can be compared. One important feature of the baseline program was to identify MPA and reference sites for future monitoring based on our knowledge of Southern California rocky reefs and historical data from our monitoring programs. We successfully identified reference areas for all MPAs in the SCSR except for the isolated Begg Rock near San Nicolas Island, Arrow Point to Lion Head Point SMCA and Lover's Cove SMCA at Santa Catalina island, and for the cluster of MPAs in Orange County on the mainland (i.e., Crystal Cove SMCA, Laguna Beach SMR, Dana Point SMCA) (Figure 3, see also Appendix A, Table A.1). With a few exceptions, these baseline reference areas seem appropriate for long-term monitoring studies (the exceptions are discussed below).

One important consideration when choosing reference areas for MPA assessment is to minimize habitat effects by ensuring that the habitat is as similar as possible at MPA and reference locations. Guided by our regional analysis that identified likely regions for MPA assessment, we compared percent cover of vertical Relief and Substrate type categories as measured by uniform point contact at MPAs and associated reference sites averaged over the baseline period (Figure 24-25). Relief is categorized into four categories (High, Moderate, Low and Flat; see methods). Most sites were characterized by low relief, followed by flat and moderate with few sites having high relief (Figure 24). Generally variation among Geographic Areas in each relief category was low with the exception of Begg Rock, which consists almost entirely of high relief. Significant differences in the multivariate Relief structure between MPA and Reference sites within Geographic Areas were only observed in Palos Verdes and Santa Catalina Island. At Palos Verdes, the habitat at the Point Vicente West and Long Point East sites within MPAs has relatively higher percentages of High and Moderate Relief than the rest of the peninsula. On the other hand, significant differences at Santa Catalina Island resulted from a couple of the sites within MPAs (Cat Harbor SMCA and Long Point SMR) having a relatively higher percentage of Flat Relief (mostly due to flat patches of sand in between boulders), while a few of the Reference sites (Ship Rock, Hen Rock and Salta Verde) have slightly higher percentages of Moderate Relief. Therefore, overall there was no consistent pattern of differences in relief among MPA and Reference sites. For Substrate type no significant differences were observed between MPA and Reference sites within any of the Geographic Areas (Figure 25). The survey sites are primarily bedrock, with lesser amounts of boulders, cobble and sand. Variation among regions was low, with only Begg Rock standing out as being almost exclusively bedrock habitat.

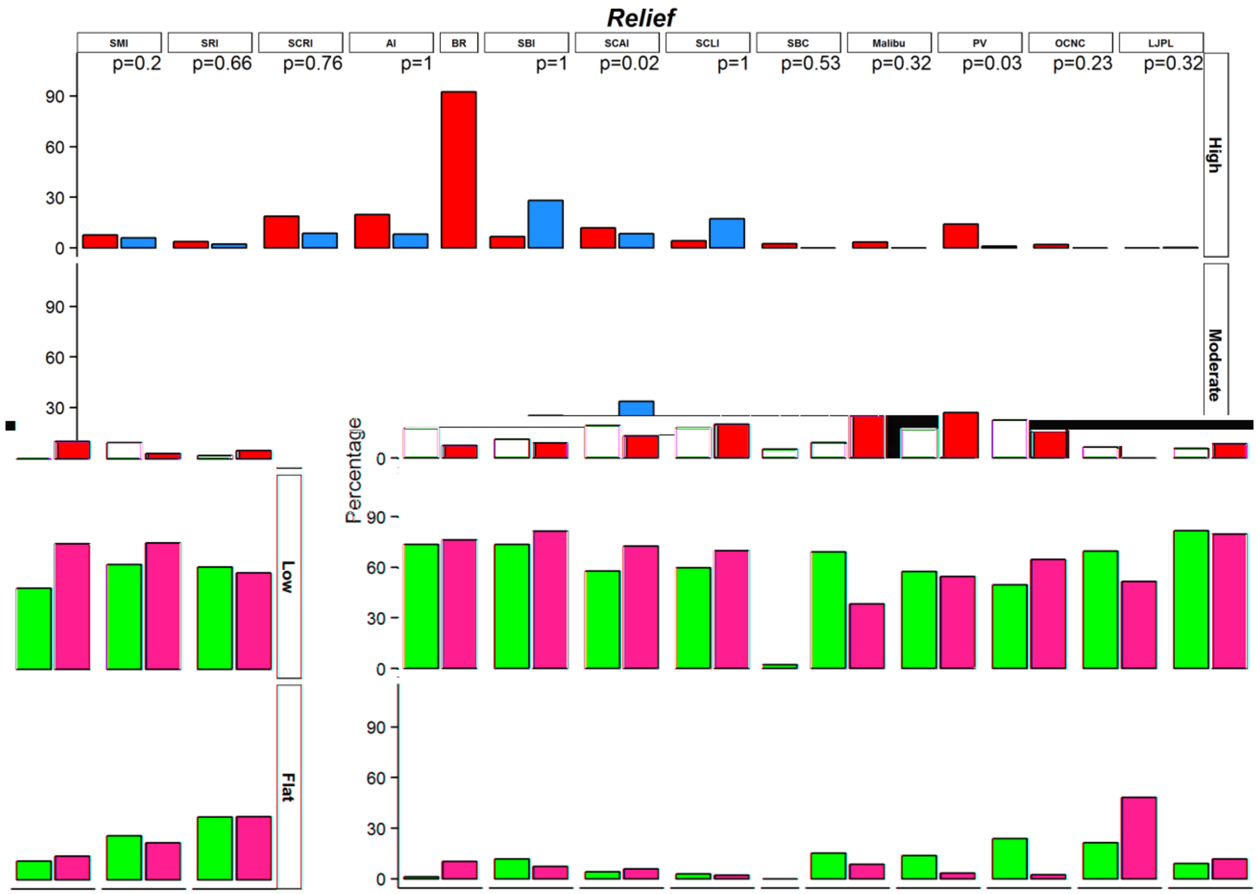


Figure 24. Mean percent cover of the four categories of vertical relief surveyed within MPAs (red) and associated reference areas (blue) in each Geographic Area (Figure 3) across 2011 and 2012. SMI: San Miguel Island, SRI: Santa Rosa Island, SCRI: Santa Cruz Island, AI: Anacapa Island, BR: Begg Rock, SBI: Santa Barbara Island, SCAI: Santa Catalina Island, SCLI: San Clemente Island, SBC: Santa Barbara County, Malibu: Malibu, PV: Palos Verdes, OCNC: Orange and North County, and LJPL: La Jolla and Point Loma. P-values are also reported for the PERMANOVA test for significant differences in the multivariate structure between MPA and Reference sites within each Geographic Area.

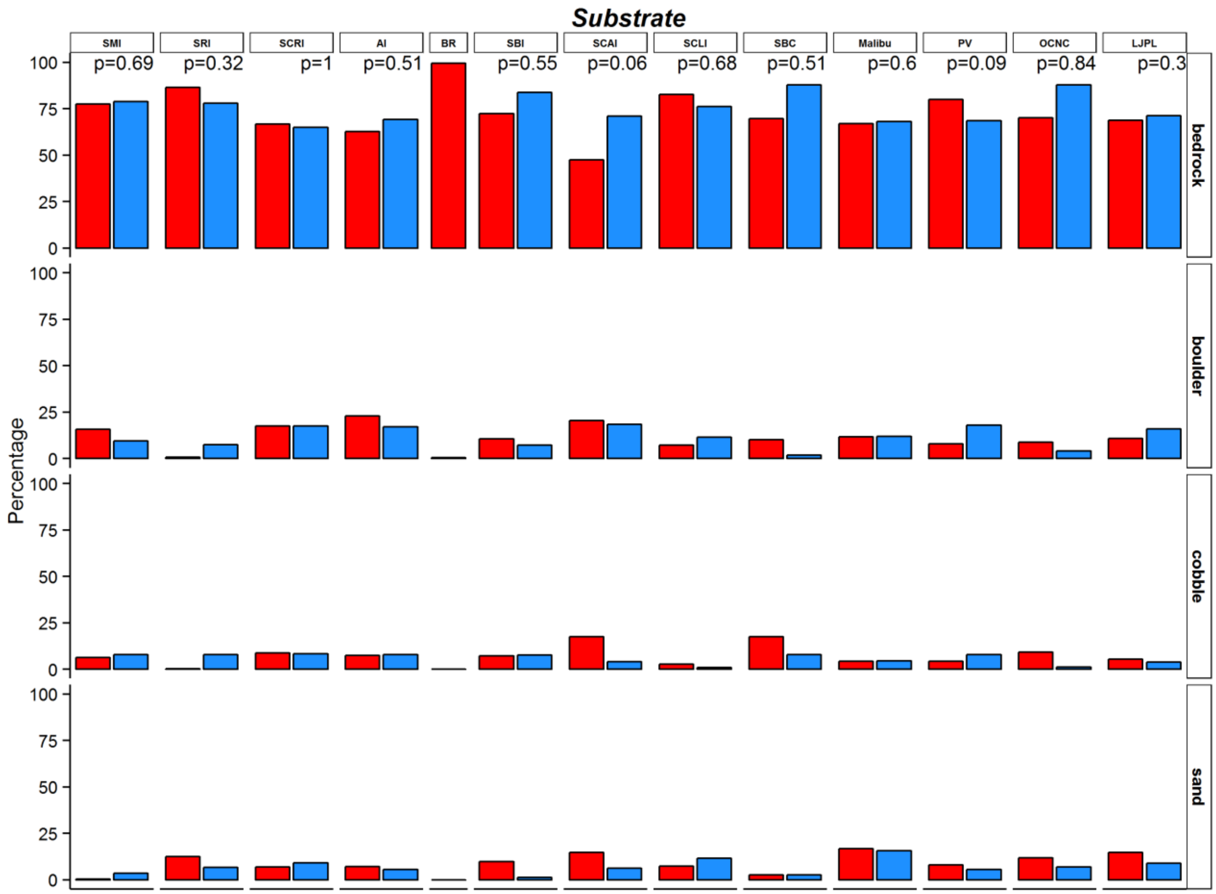


Figure 25. Mean percent cover of the four categories of substrate type surveyed within MPAs (red) and associated reference areas (blue) in each Geographic Area (Figure 3) across 2011 and 2012. SMI: San Miguel Island, SRI: Santa Rosa Island, SCRI: Santa Cruz Island, AI: Anacapa Island, BR: Begg Rock, SBI: Santa Barbara Island, SCAI: Santa Catalina Island, SCLI: San Clemente Island, SBC: Santa Barbara County, Malibu: Malibu, PV: Palos Verdes, OCNC: Orange and North County, and LJPL: La Jolla and Point Loma. P-values are also reported for the PERMANOVA test for significant differences in the multivariate structure between MPA and Reference sites within each Geographic Area.

A notable exception to the adequacy of reference areas is Begg Rock SMR, the pinnacle reef located eight nautical miles northwest of San Nicolas Island. It has unique community (Figure 4-5) and habitat characteristics (Figure 24-25). Our analyses indicate, not unexpectedly, that this offshore oceanic reef is a unique habitat with respect to island and mainland reefs in the Southern California Bight. The implications of this are that currently change over time will need to serve as the main approach to measure changes due to the removal of fishing effects by establishing the Begg Rock SMR. However, an appropriate reference for Begg Rock may be Cortez and Tanner Banks (Figure 26). However, Tanner Bank lacks the shallow habitat found at Cortez Bank and Begg Rock. Richardson Rock, off of San Miguel Island, is also a potential reference, but this reef is too difficult to access due to inclement ocean conditions. These reefs are found in the California Current, so while their benthic physical characteristics may be duplicated within the Bight, their oceanographic setting is not. While there has been deep-water surveys of these habitats using submersibles and ROVs (Love et al. 2003; Butler et al. 2006; Yoklavich et al. 2007) their role and contribution to the shallow rocky reef assemblage of the Southern California Bight is not well understood. Yet, we do know that these areas are valuable habitats for fisheries and endangered species (e.g., white abalone). Considering their unique location with respect to the Southern California Counter Current and the connectivity it affords (Hickey 1993), understanding this region of the Bight may provide substantial insight into biological processes (e.g., recruitment, larval connectivity) for the region.

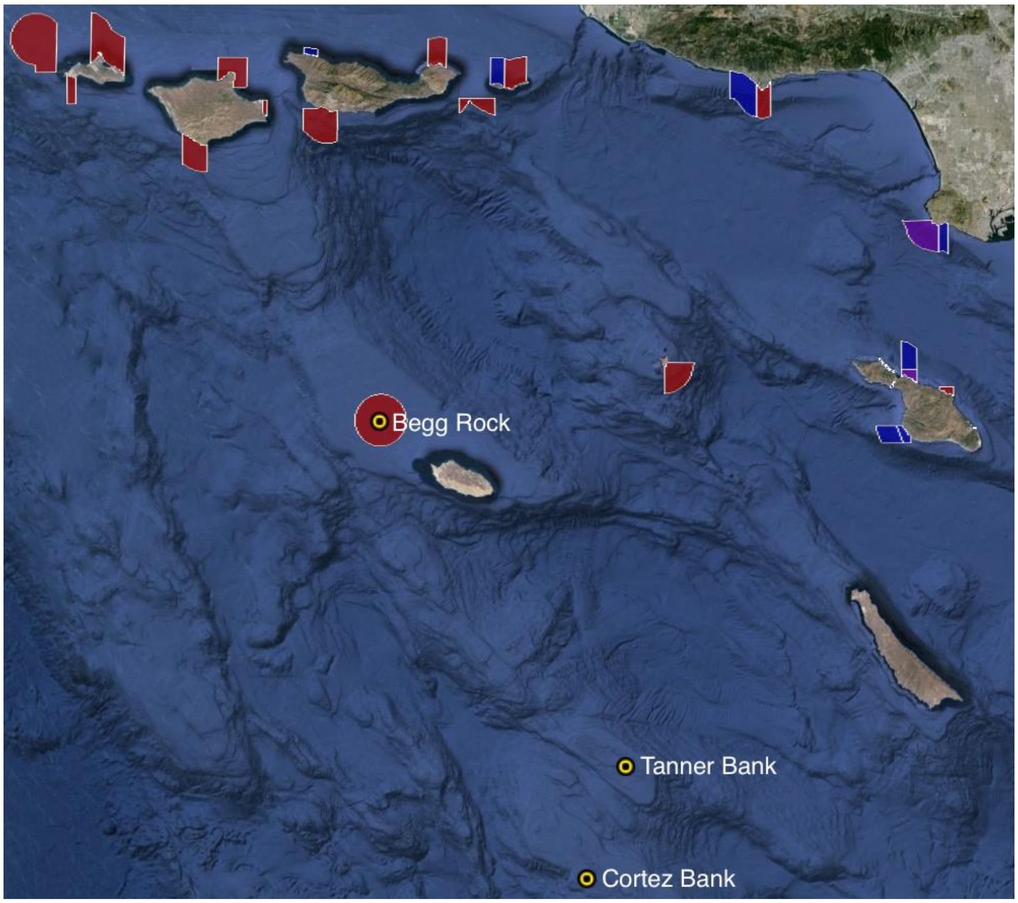


Figure 26. The location of Begg Rock SMR, the pinnacle reef 8 nautical miles northwest of San Nicolas Island, and two possible reefs that may serve as appropriate reference sites, Tanner and Cortez Banks.

The Orange County MPAs also present a complex, but interesting situation. While the whole stretch of coastline has been designated as part of different MPAs, only the middle section (Laguna Beach SMR and SMCA) is no-take. Types of fishing that are likely to impact subtidal kelp and rocky reef resources (e.g., commercial and recreational take of California Spiny Lobster and Red Urchin, recreational hook and line fishing) are permitted in the adjacent MPAs to the north and south (Crystal Cove SMCA and Dana Point SMCA). Therefore, sites in those MPAs may actually be able to serve as appropriate "open" reference areas to Laguna Beach SMR for those species. Additionally, the originally proposed reference area to the Orange County MPAs, San Mateo Kelp (site no. 84, Figure 3), does not appear to be a suitable option due to habitat differences including sedimentation effects. However, a site located further south in north San Diego County, Leucadia (site no. 86, Figure 3; currently the reference for

Swami's SMCA), could also potentially serve as a reference for the Orange County MPAs as it was grouped with those sites in the kelp forest community analysis (Figure 4).

We were able to assess habitat characteristics during the Baseline period and compare among MPAs and Reference areas. Similar habitat is one important consideration and our results indicate good match between our selected MPA-Reference pairs. However, another important consideration is the extent to which MPA and reference sites show similar temporal trajectories (in populations or habitat) prior to a management action such as implementation of MPAs. This assessment, fundamental to most control-impact statistical designs, generally requires a time series before implementation at both MPA and reference sites, something we do not have for the SCSR (or any MLPA regions). At this point, we can only assume that the temporal dynamics of a reference area and associated MPA are similar, that is, track together in time. As we gather more historical data that is geographically widespread and predates the implementation of MPAs (e.g., kelp biomass from satellite imagery), we may be able to assess this important statistical consideration.

MPA Versus Reference Sites: Size Frequency

A well-documented effect of protection in MPAs is an increase in the size structure of populations relative to areas open to fishing. Our fish surveys include the sizes of all species observed, which not only permits us to calculate biomass (widely used in fisheries models), but also permits us to compare the size structure for any fish species in the survey. Previous estimates of size structure for invertebrates in southern California have largely been limited to a few commercial and recreationally important species including urchins, lobsters and abalone. For the first time, we assessed the size structure of a number of additional invertebrate species, many of which are targets of emerging fisheries in the SCSR. These included Kellet's Whelk (*Kelletia kelletii*), Wavy Turban Snail (*Megastraea undosa*), and Giant Keyhole Limpet (*Megathura crenulata*) in addition to urchins, lobsters and abalone. We present the full range of size structure plots in Appendix E, Figure E.1-E.12.

Two common focal species, Kelp Bass (*Paralabrax clathratus*) and California Sheephead (*Semicossyphus pulcher*), both exhibited no strong differences in size structure between MPA and reference sites with the exception of the older reserves at the Northern Channel Islands (Figure 27, 28). At most NCI reserves, both California Sheephead and Kelp Bass were significantly larger inside protected areas (i.e., 95% CIs of mean size did not overlap). There were exceptions such as Harris Point reserve at San Miguel Island, Anacapa Island SMR and Santa Barbara Island SMCA. Newly implemented MPAs in the SCSR, not surprisingly, did not show size structure differences for these species. In most cases, invertebrate species did not display similar patterns to fish. For example, both the Wavy Turban Snail and the Giant Keyhole Limpet did not show strong size structure patterns in either the older NCI reserves or the newly implemented mainland reserves (Figure 29, 30). This may relate to the spatial patterns of fishing pressure as well as the lack of size regulations on these species. If they were not harvested heavily in the Northern Channel Islands we would not expect to see responses in size structure at those reserves, and without size limits on these fisheries there is less size-selectivity in harvesting efforts.

MPA Versus Reference Sites: Interannual Variation

We provide density estimates (#/100m^2 ± standard error) of focal kelp and benthic macroinvertebrate species for each individual MPA and its reference site(s) for 2011 and 2012 in Appendix F, Table F.1-F.31. Mean fish numerical densities (#/100m^2 ± 1 standard error) and biomass densities (g/100m^2 ± 1 standard error) for the 23 focal fish species are presented in Appendix G, Table G.1-G.31. While biomass and size structure differences over a period of ten years since implementation in the Northern Channel

Islands MPAs are evident (see *Historical Trends: Channel Islands Marine Reserves* section below; Figure 31-33), we would not anticipate detectable changes in any of these metrics of species abundance (biomass, density or percent cover) or community structure that could be attributed to the protection by the newly established MPAs so soon after their implementation (i.e., less than one year). As such, formal assessments of "initial changes" were not included as part of our monitoring proposal and we did not statistically test for differences between years (2011 versus 2012) in metrics of community structure, species abundance and population size structure of key species because of the a) lack of statistical power to detect change and b) our inability to ascribe any change to MPAs given the life history characteristics of targeted species relative to the less than one year time period since the effect of fishing had been removed. Instead, we present all baseline data here and make recommendations that monitoring continue in order to better understand the effects of MPAs over time (see Monitoring recommendations).

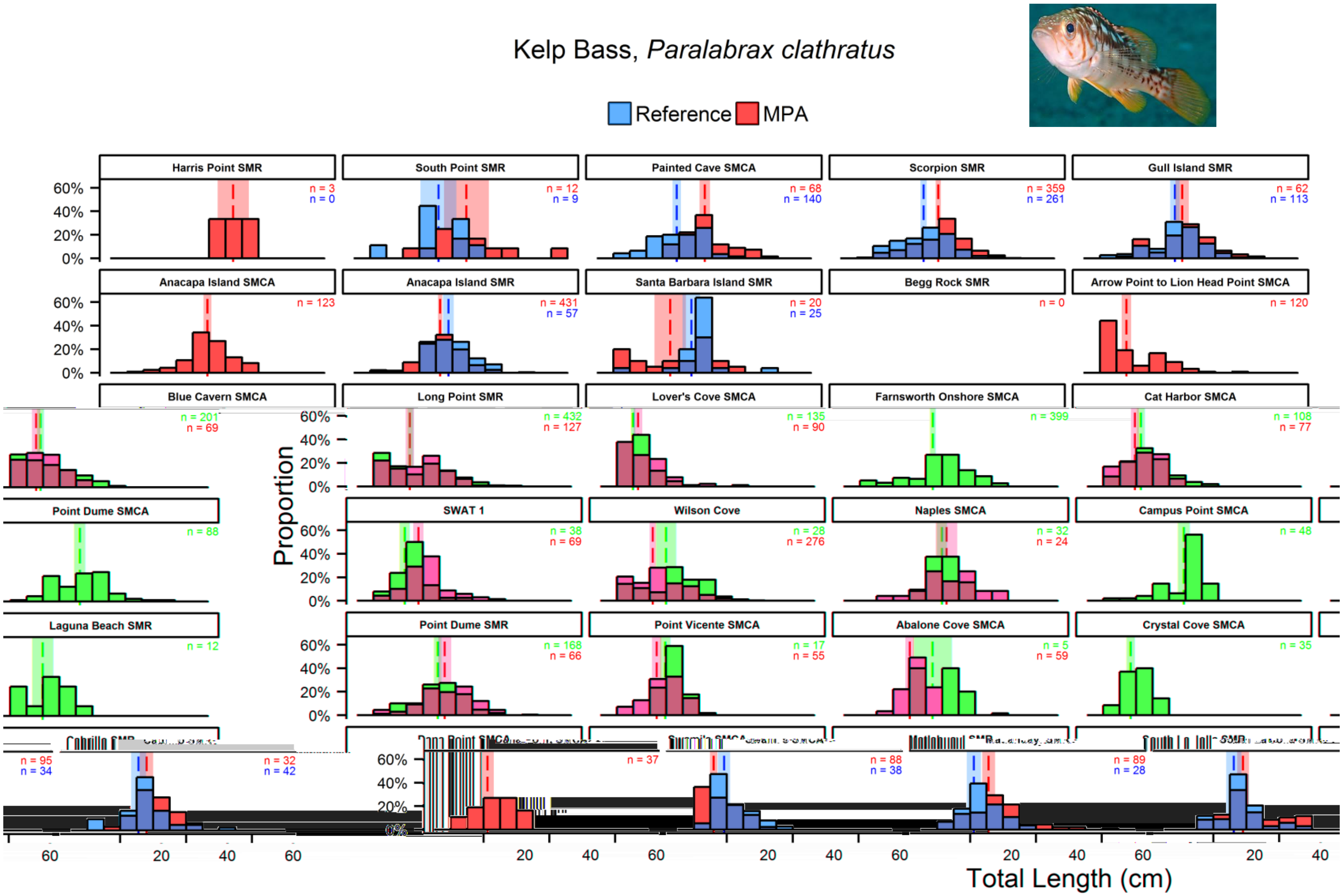


Figure 27. Kelp Bass (*Paralabrax clathratus)* size structure by MPA (red bars) and reference (blue bars). The total number of fish observed is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

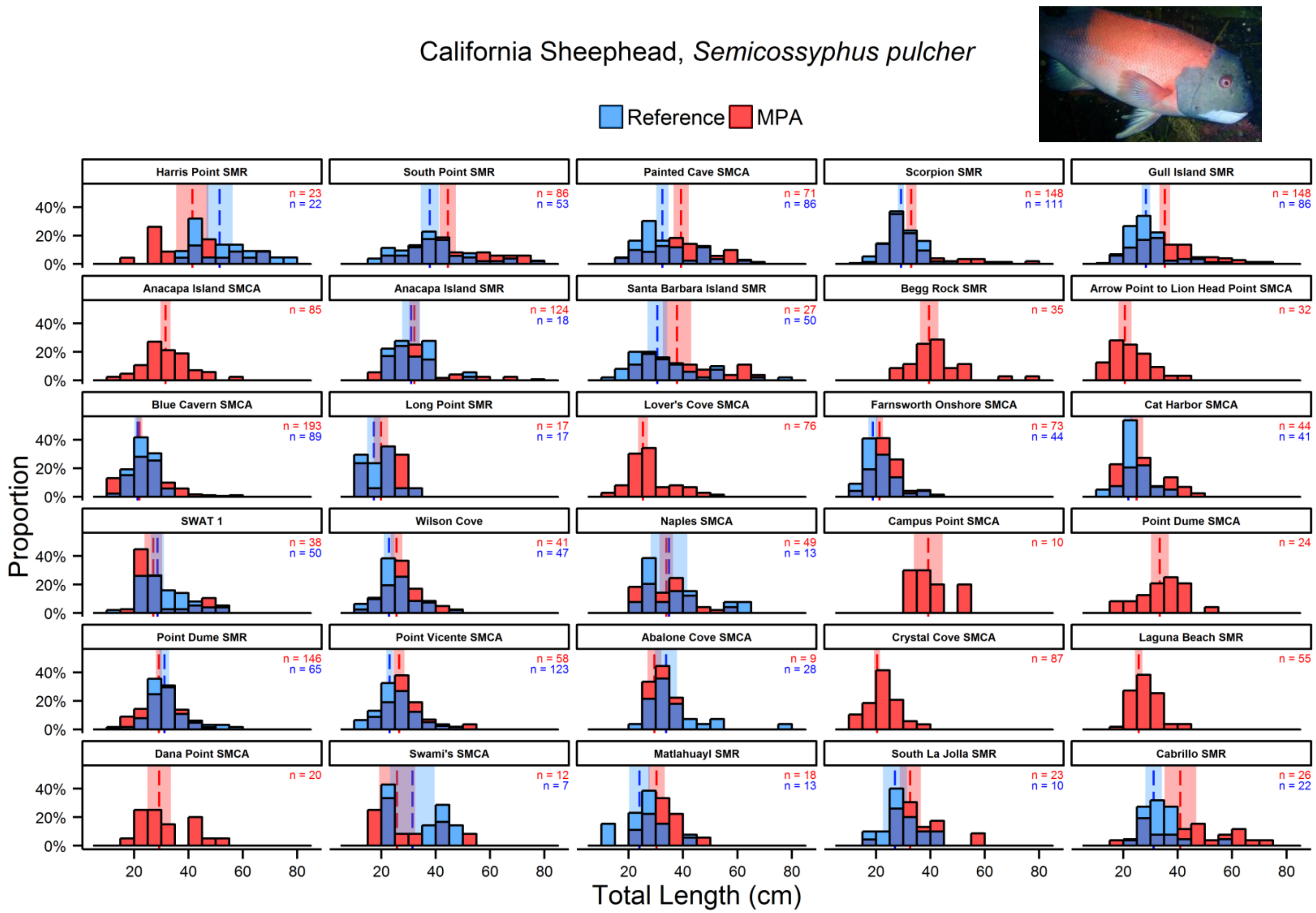


Figure 28. California Sheephead (*Semicossyphus pulcher)* size structure by MPA (red bars) and reference (blue bars). The total number of fish observed is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

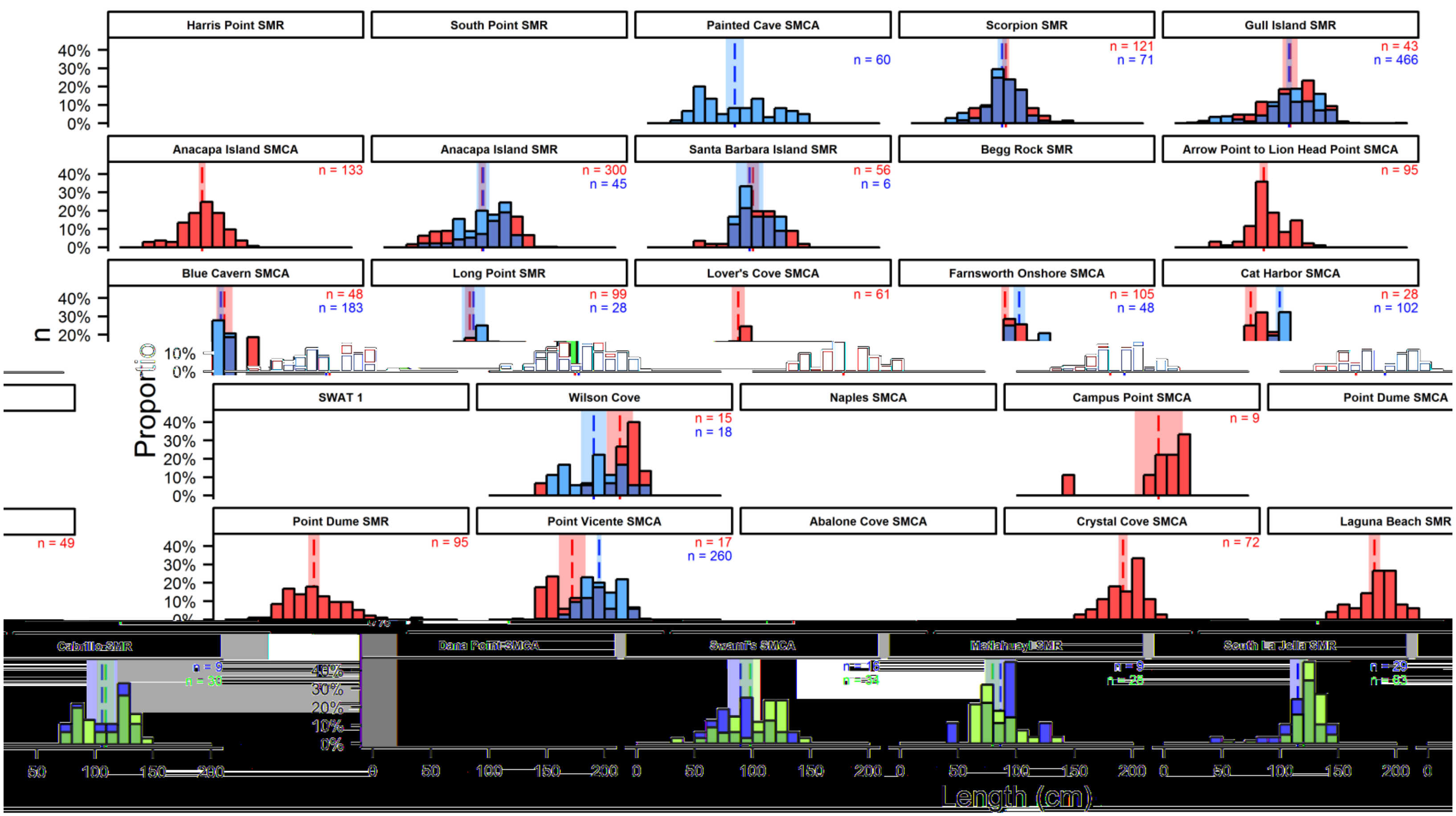


Figure 29. *Megastraea undosa* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

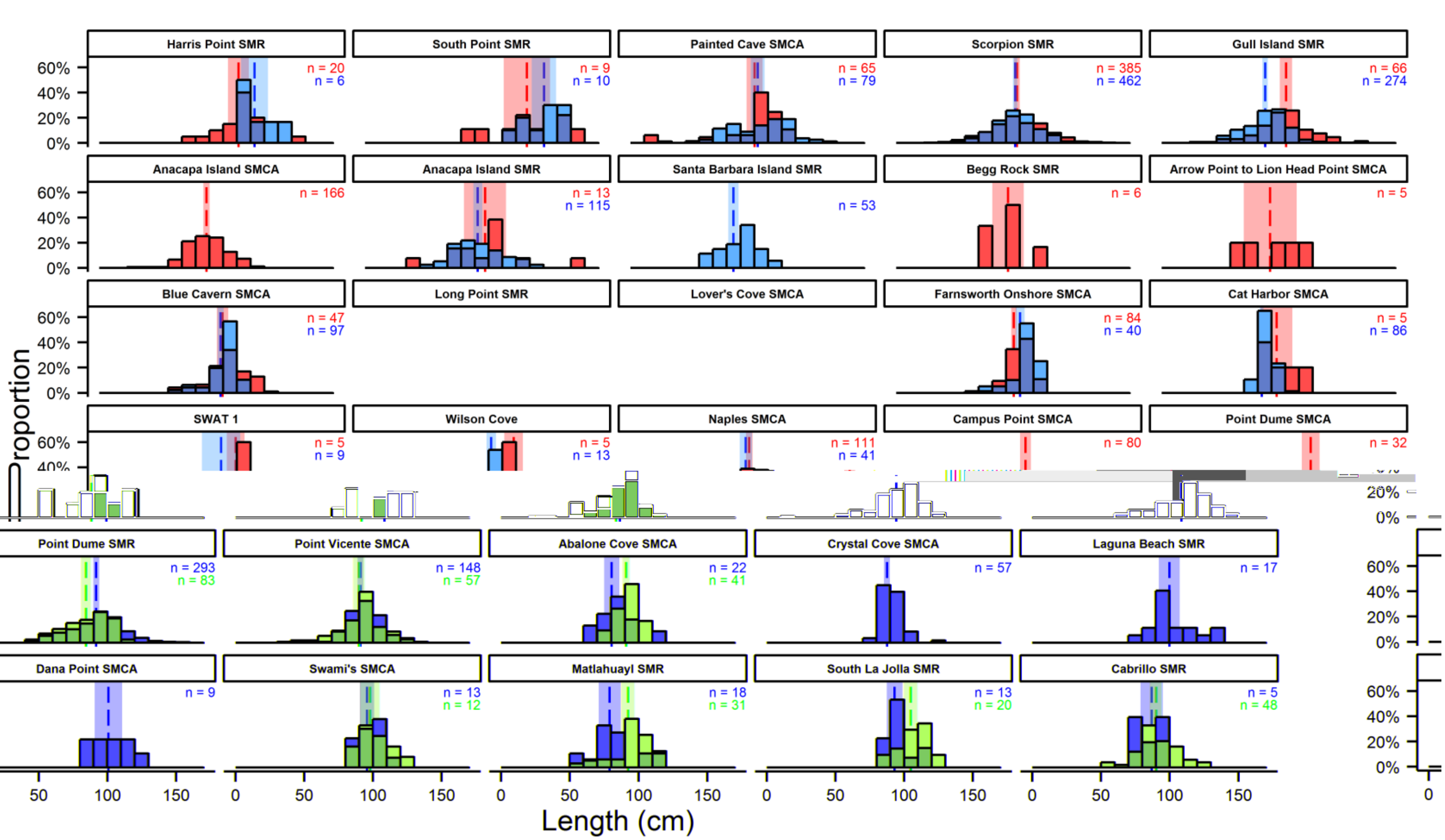


Figure 30. *Megathura crenulata* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

Historical Trends: Channel Islands Marine Reserves

Background

In 2003, a network of MPAs was implemented across the northern Channel Islands, predating the implementation of the MLPA South coast MPAs. In 2008, we conducted a review of the responses of kelp forests organisms in NCI MPA network, five years after implementation (California Department of Fish and Game 2008; Hamilton et al. 2010). At that time, we showed that the abundance (numbers of fish) and biomass (total weight of fish) of fish species targeted by fishers in the region were both greater inside the reserves relative to the outside reference sites. We used a statistical model to control for the effects of environmental influences and biogeographic variation in the kelp forest communities across the network. Those analyses were limited to the first five years of monitoring data (2003-2008) and the patterns we showed were aggregated averages over that time period. Assessing the patterns of changes over time was impossible after such a short post-implementation period. In addition, we focused the prior analyses on fish species and did not present data on invertebrates, although they comprise very important fisheries in the NCI and SCSR.

Kelp forest monitoring in the NCI has continued (as part of PISCO and this Baseline Survey) and here we build on our prior work by updating the analyses we conducted in 2008 and adding information on trajectories of change across the network over a period of 10 years since MPA implementation (Caselle et al. in prep). In addition, we investigate the responses of common invertebrate species (both targets of fishing and non-targeted) to the MPAs.

Much of our analysis focuses on the differences between targeted and non-targeted species as we hypothesize that the effects of reserves, by eliminating fishing pressure, should be greatest on those species that are targeted (i.e., fished). We do expect reserves to affect non-targeted species through trophic interactions (e.g., buildup of predators affecting prey species in reserves) but these indirect effects generally take much longer to manifest and can be difficult to detect in highly dynamic temperate ecosystems (Babcock et al. 2010). Ongoing monitoring will likely provide that type of information in future years.

Results and Discussion

Generally the patterns of abundance, size structure and biomass are similar to those observed five years after MPA implementation. At the ten-year mark, biomass of targeted fishes was significantly greater inside reserves relative to outside (Figure 31A, $F_{1,494}$=59.3, $P < 0.0001$). For non-targeted species, there was a significant interaction between reserve status and island (Figure 31, $F_{3,494}$ =2.8, $P <0.05$), making interpretation of any reserve effect complex. In many cases, the differences we saw inside and outside of reserves after five years are now greater after ten years (Figure 31A). Biomass of targeted fish both inside and outside of reserves has increased since the five-year review, but the increase is much greater inside reserves. On average, the biomass of targeted fish species has increased 52% inside MPAs since the last assessment, but has also increased 23% outside MPAs. Biomass of non-targeted fish has also increased since the five-year review, but is similar inside and outside reserves (28% inside and 23% outside). While more work is needed to demonstrate that the increase in targeted species outside MPAs is due to spillover from MPAs, this result does allay worries voiced at implementation that these species would decline precipitously outside MPAs due to redistribution of fishing effort.

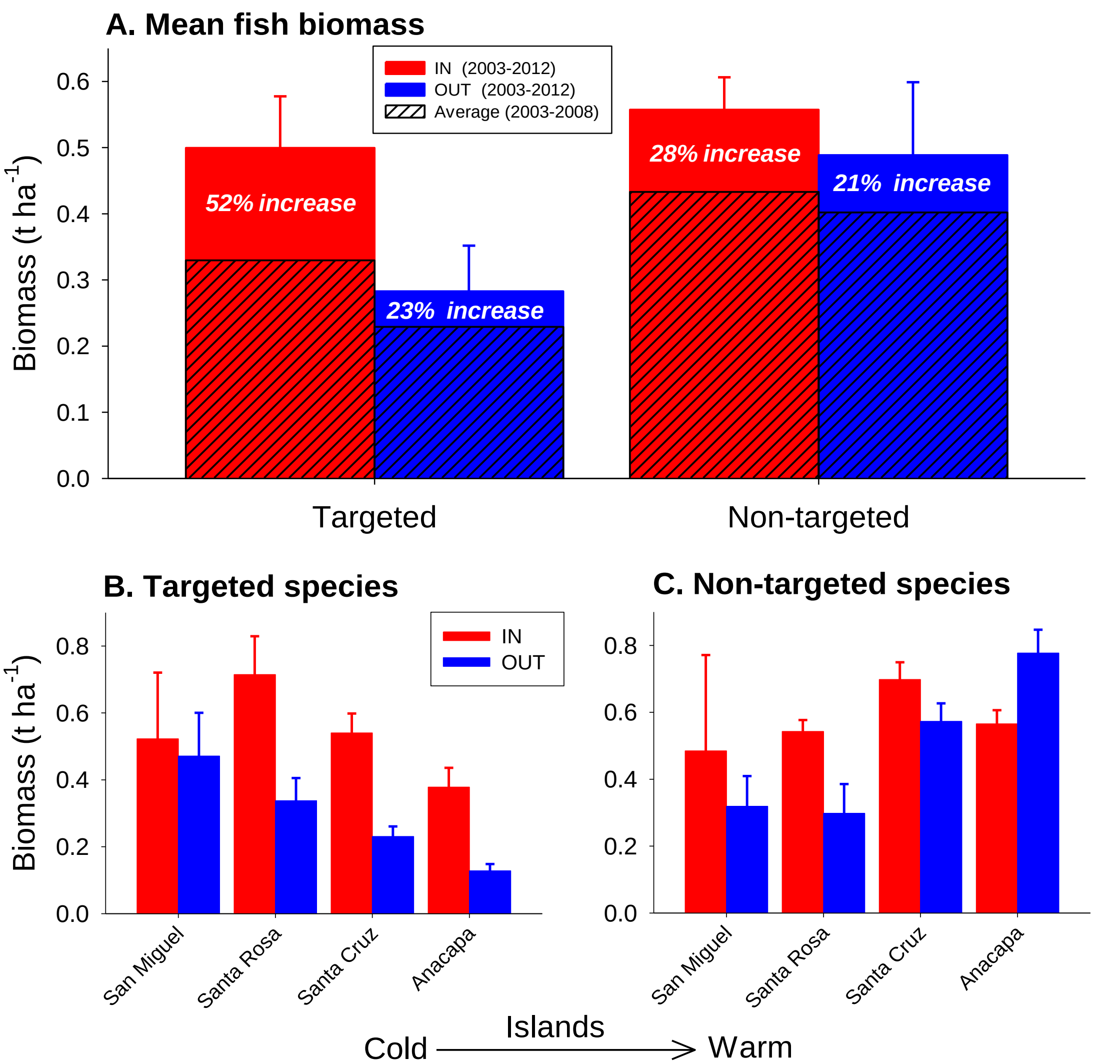


Figure 31. Results from the Channel Islands MPA network, implemented in 2003, prior to the implementation of the remainder of the South Coast MLPA network. (A) Total biomass for fish species targeted by fishing and species not targeted, inside MPAs (red bars) and outside MPAs (blue bars). Red and blue bars show the ten-year average biomass (from 2003-2012, plus one standard error). The black inset bars show the same data but calculated for the first five years (average from 2003-2008). Spatial patterns of biomass for (B) targeted and (C) non-targeted species inside (red bars) and outside (blue bars) of reserves in the Channel islands. Average biomass for years 2005-2012 is shown with 1 SE.

We also found similar geographic patterns across the islands to those discovered during the five-year review. The biomass of targeted and non-targeted fish species, as well as the reserve effect, differed among islands, with some islands showing larger differences than others (Figure 31B-C). For targeted species, there was significant variation in biomass among islands (Figure 31B, $F_{3,494}$=18.4, $P < 0.0001$) with generally greater fish biomass in the western islands. An interaction between reserve status and island was non-significant ($F_{3,434}$=2.3, $P > 0.05$) indicating that the positive reserve effect did not differ across islands. All islands except San Miguel showed much higher biomass inside relative to outside MPAs. At the coldest island, San Miguel, we did not detect differences in the ten-year (current) average biomass inside versus outside the single MPA we monitor at that island. This result was similar to the pattern at the five-year mark, where biomass at San Miguel was also only slightly and non-significantly higher inside MPAs (Hamilton et al. 2010). As expected, non-targeted species (Figure 31C) had mixed responses across the islands with greater biomass outside MPAs at Anacapa, inside MPAs at Santa Cruz and Santa Rosa, and no differences at San Miguel Island (significant reserve*island interaction, $F_{3,494}$ =2.8, P <0.05). The NCI is a microcosm of the larger SCSR in terms of strong environmental variation (albeit over smaller spatial scales). The variation in MPA responses shown here is also likely to manifest across the SCSR as monitoring time series data continue to be gathered.

The five-year review of the NCI MPA network focused primarily on spatial patterns and less on changes over time. Trajectories of biomass and density of kelp forest organisms require longer time series to detect increases or decreases against a backdrop of natural year-to-year variability than were available at the five-year mark. While some studies have indicated that it might take 13+ years to detect changes in MPAs (Babcock et al. 2010), we detected differences in the trajectories of change between reserves and reference locations, but only for fish species that are targets of fishing (Figure 32). The change in biomass from 2003 to 2012 for targeted species is shown in Figure 32. First, we see that there is a large amount of variation from year to year. Temperate kelp forest communities are well known to change dramatically in relation to environmental conditions that can cause changes in dominance from one set of organisms to another. However, despite the variability, the trajectory of change is positive and steeper inside MPAs compared with the change outside (Figure 32A; ReserveStatus*Time interaction; $F_{1,428}$=19.79, P < 0.0001). Inside reserves, biomass increased gradually and steadily from 2003 through 2008, after which we observed a large increase and large variability from 2009-2012. Outside reserves, fished species biomass has not changed dramatically over time. Figure 32B shows the trajectories of time inside and outside reserves for non-targeted fish species. By contrast, non-targeted species biomass shows no significant reserve effect or interaction between reserve status and time (P > 0.15 for each factor). Non-targeted biomass is increasing over time ($F_{1,428}$=8.62, P < 0.0035) but the changes in time are highly variable and appear to track each other inside and outside. This pattern is not unexpected as the non-fished species group contains a large variety of species with different life histories and mortality patterns and MPAs are hypothesized to affect these species less.

The trajectories shown in Figure 32 are aggregates of all species making up the targeted and non-targeted groups. We can also investigate the times series for individual species (Figure 33). We did this by calculating the slopes of the trends through time for a number of species. Positive slopes indicate increases over time while negative slopes would indicate a decline. Slopes close to 0 can indicate no change over time or highly variable patterns over time. The slopes for individual, common species are presented in Figure 33. These are both fish and invertebrates species and are organized by the levels they are fished in the Channel Islands. For highly fished species, slopes of change inside reserves are all positive, some highly so. Outside of reserves, for these species, some are increasing, some are decreasing and some show little change. While these data alone, cannot prove that fished species are increasing on the outside of reserves due to spillover, it is clear that all fished species are not declining greatly in the non-reserve areas. Lightly fished species and non-fished species show mixed patterns of increase and decrease as expected. These species trajectories may be related simply to recruitment variability and environmental change without the added effect of fishing.

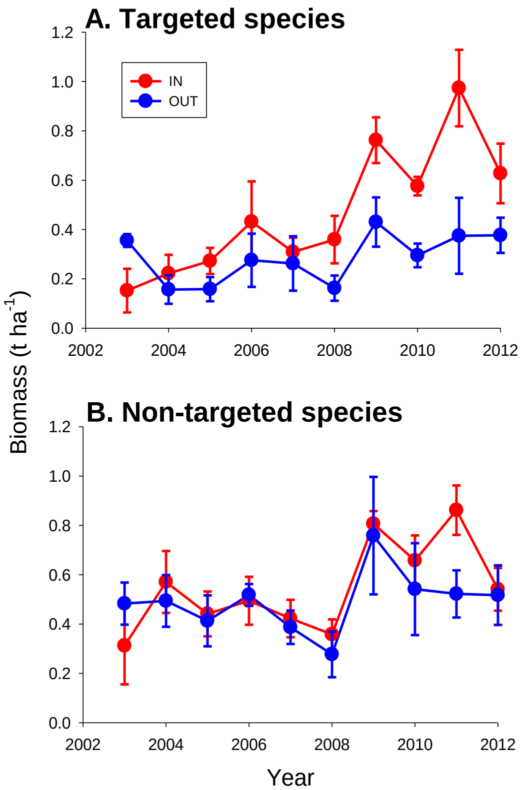


Figure 32. Change over time of average biomass inside (red) and outside (blue) marine reserves across the Channel Islands for (A) species targeted by fishing and (B) species not targeted by fishing. Error bars are +/- 1 SE.

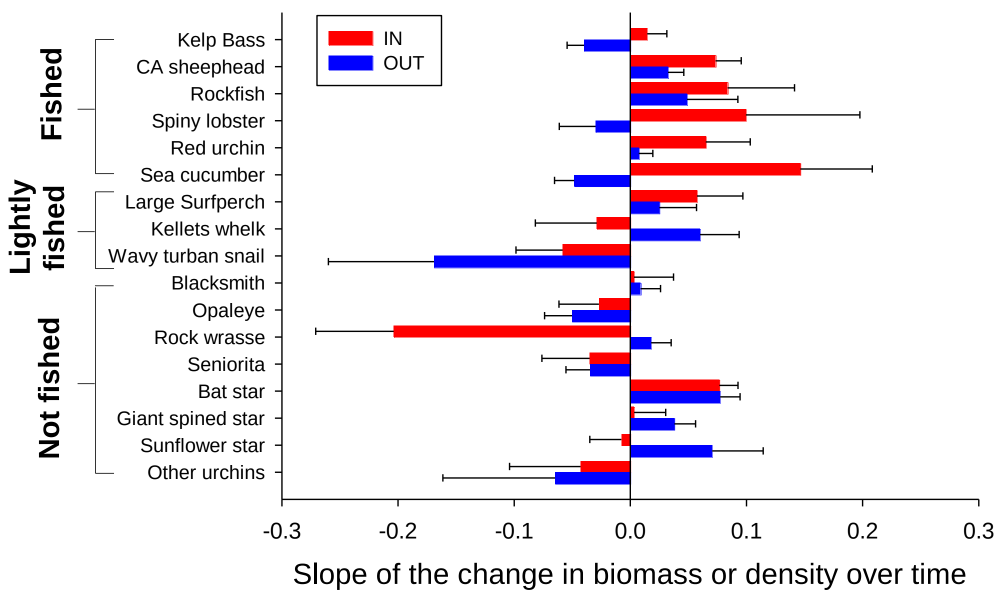


Figure 33. Mean slope (+/- 1 SE) for individual species trajectories from 2003 to 2012 at each site. Slopes represent changes in density of fishes (A) and for invertebrates (B). Slopes are calculated as the proportion of the average species biomass or density over the entire time series to account for large difference in these values across the network.

Summary
Our reanalysis of the PISCO kelp forest monitoring data through 2012 indicates the patterns we observed during the five-year review of the network of MPAs, especially those of species most likely to benefit from MPAs (i.e., fished species with limited mobility), have remained similar. Importantly, with ten years of post-implementation data, we can begin to analyze the trajectories of change, something that was not possible with only five years of data. We also extended the previous analysis by including important invertebrate species on reefs in the Channel Islands.
We found:

- Overall, there is more fish biomass inside the reserves compared to outside control areas for fish species targeted by fishing. There are no consistent reserve effects for the wider diversity of unfished species (Figure 31, 33).
- There are strong biogeographical patterns across the Channel Islands. Only the coldest island, San Miguel, showed no difference in fished species biomass inside and outside the reserve. One explanation may be that San Miguel, the most distant island from ports, is more lightly fished than the other islands (Figure 31).
- Three of the five targeted invertebrate species in the rocky reef data (California Spiny Lobster, Warty Sea Cucumber and Red Urchin) were more abundant inside reserves, while two species (Wavy Turban Snail and Kellet’s Whelk) that are the targets of emerging fisheries, were more abundant outside reserves. If the emerging fisheries continue to increase, this pattern may change.
- Despite large fluctuations from year to year, fished species biomass is increasing faster inside MPAs compared with the outside, where little change was observed over time (Figure 32).
- Individual fished species all increased over time inside reserves while outside reserves, some increased, some decreased and some showed little change (Figure 32).
- Strong differences in biogeography and environmental conditions as well as natural fluctuations in highly dynamic temperate kelp forests complicate detection of reserve effects. Ongoing monitoring across the region and through time will be critical to assessing further change in NCI as well as the SCSR MPA network

Candidate Indicator Species Evaluation

One objective of the baseline program is to assess candidate system indicators and examine potential new candidates. Ecological indicators are becoming mainstream tools for assessing impacts of human disturbance and general environmental ‘quality’ (Donnelly et al. 2007). There are hundreds to thousands of potential indicators of ecosystem status that can be used for management. They range in complexity from single-species indicators to ‘emergent properties’ of ecosystem models (Rice 2003). Indicators are useful when they condense composite biological information into single measures, which might be more understandable for the general public and easier to deal with for non-scientific users, such as decision makers involved in environmental management. As indicators are used for different purposes in ecology and conservation, many argue that their selection depends on the issue at stake (Failing 2003; Heink and Kowarik 2010). However, any good ‘indicator’ must ultimately be related to the phenomena of interest that the indicator reflects (Heink and Kowarik 2010).

In the MLPA SCSR baseline Kelp and Shallow Rock Ecosystems project we are mainly concerned with biophysical indicators since these are the ones of primary interest to scientists and those measured in this project. Regardless of their many social benefits, MPAs are ultimately a tool for conserving or restoring the biological and physical conditions of oceans and coasts. In most cases the link between the biological state of the marine environment and the livelihoods, income and food security of the people who use and depend upon the resource is explicit. It then follows that beyond characterizing natural systems, the measurements of biophysical indicators can also be useful when viewed in the context of the socio-economic and governance conditions that operate in and around the MPA (Pomeroy et al. 2004). These links are the subject of other Baseline projects, here we evaluate biological indicators identified in the MLPA South coast monitoring plan according to several criteria common to 'indicators' in general. While specific indicators will depend on the specific management or ecological objectives (Leonard et al. 2006), at a minimum they should be:

(1) Easy to measure (e.g., cost-effective, readily observed/identified, relatively common)
(2) Suitable for statistical analyses or 'robust' (e.g., low random variation among samples)
(3) Indicate something:
    a. Sensitive to anthropogenic perturbations or a manageable human activity in a predictable way, and/or
    b. Strong ecological driver
(4) Applicable to a variety of temporal and spatial scales as well as habitats.

To date, decisions about indicators for the MLPA have resulted from various forms of 'expert judgment' and stakeholder input. Early in the MLPA process, workshops were held with citizen stakeholders, scientists, and managers to gauge the opinions about the utility of various components of the ecosystem to function as indicators. With few exceptions, none of these processes were data driven in a classical sense (although expert judgment can be considered a form of "data"). Here we attempt to move the discussion forward with a quantitative evaluation of various identified and potential indicators. Specifically, we provide an evaluation of whether proposed indicators for the SCSR possess general characteristics that are desirable for good indicators (addressing aspects of number 1, 2 and 4 above). For each species we calculated multiple statistics, which describe elements of their spatial distribution and underlying statistical properties. These include:

- **Total number of Geographic Areas** (as previously defined in the Baseline Characterization section) the species was observed on transects. As discussed previously in the *Baseline Characterization - Focal Species* section above, some species tend to show either northern or southern geographic patterns of distribution across the SCSR. Therefore, it is import to evaluate the extent of geographic applicability of an indicator across the SCSR.
- **Mean Density (No./100m^2)** to assess the relative abundance of a given species. In most cases, rare species would not be considered good candidates for indicators.
- **Mean Frequency of Occurrence** at sites in a given Geographic Area. It is important that indicators are commonly observed in both MPAs and Reference sites within a given Geographic Area.
- **Mean spatial Coefficient of Variation** (CV; ratio of the standard deviation to the mean site specific density) across sites in a given Geographic Area during a given year. Ideally good indicators will have low variance in space (evaluated here) and this will be maintained over time.

To calculate each statistic we used the SCSR Baseline and the historical data from CRANE in 2004 and Bight ’08 in 2008. Additionally, as described in the Baseline Characterization section, previous studies using fish communities performed on an island scale in the NCI demonstrated the statistical benefit of incorporating biogeography (i.e., analyzing effects separately within biogeographic groups) when evaluating impacts of MPAs (Hamilton et al. 2010). Therefore, “Geographic Areas” within the SCSR were *a priori* defined based on the kelp forest community cluster analysis described above, geographic location (island vs. a mainland area), and known biogeographic and habitat breaks. Metrics for the indicator evaluation were calculated excluding the Geographic Areas where the indicator was not observed, and values were calculated across sites in a given Geographic Area and then averaged across years sampled and across Geographic Areas.

We included species in our evaluation that likely “indicate something” (i.e., number 3 above), drawing from those listed in MLPA South Coast Monitoring Plan as “Draft Vital Signs” and “Draft Indicator/Focal Species” (see the SCSR Monitoring Plan for more detail on what each species may indicate, as that is not the focus of this initial evaluation and will depend on the specific purposes of future analyses). Note that indicators included in the Draft Vital Signs list are in some cases simplified because Vital Signs were designed so that they could potentially be assessed using data gathered by community and citizen-science groups. For example, given the challenges associated with identifying rockfishes to species without extensive training, the list includes all rockfish species pooled together. However, here we have included the individual rockfish species in our evaluation, as we do not agree with the utility of lumping all rockfishes together. Additionally, we also include species that were observed in high abundance in the Baseline data and invertebrates that are considered to constitute “emerging fisheries”.

Several species evaluated here appear to be good candidates for indicators that are applicable to the entire, or at least most of, the SCSR. The fact that most species may only be useful as indicators for a geographic subsection of the SCSR is expected given the strength of environmental gradients across the SCSR and associated high degree of kelp forest community structure across the region (see Baseline Characterization section). Kelp Bass (*Paralabrax clathratus*) and California Sheephead (*Semicossyphus pulcher*) are two of the most economically and ecologically valuable rocky reef fishes in southern California, making them likely candidates as indicator species for MPA evaluation. Based on the calculated metrics, both of these species have characteristics of desirable indicator species for the SCSR. Both occurred in at least 13 of the 14 geographic areas (Table 1; also see Figure 13, Appendix C, Figure C.7), were relatively abundant (i.e., moderate mean density), had relatively low spatial CVs (i.e., were observed at similar densities across sites within a Geographic Area in a given year) and had high frequencies of occurrence in the Geographic Areas where they were observed. Conversely, the calculated metrics for Barred Sand Bass (*Paralabrax nebulifer*) and Cabezon (*Scorpaenichthys marmoratus*), also important fished species, displayed the opposite pattern (i.e., relatively lower density and frequency of occurrence, higher spatial CV). In the case of Barred Sand Bass, these characteristics are likely reflective of their habitat preferences and movement patterns. While they tend to live on rocky reefs during some of the year, they migrate to soft bottom areas during the summer to form spawning aggregations (Mason and Lowe 2010; McKinzie et al. 2014), moving out of the habitat we surveyed during most of our annual field season.

Table 1. Statistics to evaluate the applicability of SCSR fish species as indicators calculated from the SCRS Baseline and historical (CRANE 2004 and Bight '08 2008) data. Metrics were calculated across sites in a given Geographic Area, excluding the Geographic Areas where the indicator was not observed. Values were then averaged across years sampled and across Geographic Areas. MME Focal Type: Draft classifications used in SCSR Monitoring Plan, DI/FS = "Draft Indicator/Focal Species", DVS = "Draft Vital Sign", DVS-R = "Draft Vital Sign – Rockfish"; Areas: total count of Geographic Areas (out of 14) where the species was observed on transects; Range: Range of site specific density values.; Mean CV: spatial Coefficient of Variation across Sites in an Geographic Area; Mean Freq. Occur.: Ratio of number of sites the species was observed on a transect in an Geographic Area, divided by the total number of sites in the Geographic Area.

Species	Common Name	MME Focal Type	Areas	Mean Density (No./100m^2)	Range	Mean CV	Mean Freq. Occur.
Brachyistius frenatus	Kelp Perch	—	13	5.11	(0 - 71.2)	1.06	0.82
Chromis punctipinnis	Blacksmith	DI/FS	14	19.51	(0 - 609.9)	1.28	0.85
Embiotoca jacksoni	Black Perch	—	13	1.61	(0 - 17.9)	0.80	0.93
Girella nigricans	Opaleye	—	13	2.28	(0 - 62.9)	1.14	0.78
Hypsypops rubicundus	Garibaldi	—	12	1.83	(0 - 16.1)	1.08	0.78
Oxyjulis californica	Senorita	DI/FS	13	10.75	(0 - 102.5)	0.85	0.95
Paralabrax clathratus	Kelp Bass	DVS	13	3.3	(0 - 36.9)	0.89	0.85
Paralabrax nebulifer	Barred Sand Bass	DI/FS	6	0.93	(0 - 30.8)	1.47	0.63
Scorpaenichthys marmoratus	Cabezon	DI/FS	11	0.07	(0 - 1.1)	1.89	0.31
Sebastes atrovirens	Kelp Rockfish	DVS-R	13	1.16	(0 - 19.9)	1.09	0.71
Sebastes auriculatus	Brown Rockfish	DVS-R	6	0.04	(0 - 1.2)	2.17	0.21
Sebastes carnatus	Gopher Rockfish	DVS-R	11	0.1	(0 - 1.7)	1.91	0.34
Sebastes caurinus	Copper Rockfish	DVS-R	8	0.12	(0 - 1.1)	1.52	0.46
Sebastes chrysomelas	Black-and-yellow Rockfish	DVS-R	11	0.09	(0 - 1.0)	1.61	0.37
Sebastes miniatus	Vermilion Rockfish	DVS-R	8	0.05	(0 - 1.6)	1.95	0.20
Sebastes mystinus	Blue Rockfish	DVS-R	11	2.34	(0 - 41.9)	1.36	0.57
Sebastes paucispinis	Bocaccio	DVS-R	8	0.04	(0 - 2.6)	2.39	0.09
Sebastes rastrelliger	Grass Rockfish	DVS-R	10	0.01	(0 - 1.2)	2.16	0.10
Sebastes serranoides	Olive Rockfish	DVS-R	9	0.3	(0 - 8.5)	1.95	0.25
Sebastes serriceps	Treefish	DVS-R	13	0.05	(0 - 0.8)	1.81	0.30
Sebastes umbrosus	Honeycomb Rockfish	DVS-R	1	0.06	(0 - 0.7)	2.32	0.14
Semicossyphus pulcher	California Sheephead	DVS	14	2.7	(0 - 18.8)	0.67	0.93
Stereolepis gigas	Giant Sea Bass	DI/FS	6	0.01	(0 - 0.3)	2.15	0.09

Table 2. Statistics to evaluate the applicability of SCSR invertebrate species as indicators calculated from the SCRS Baseline and historical (CRANE 2004 and Bight '08 2008) data. Metrics were calculated across sites in a given Geographic Area, excluding the Geographic Areas where the indicator was not observed. Values were then averaged across years sampled and across Geographic Areas. MME Focal Type: Draft classifications used in SCSR Monitoring Plan, DI/FS = "Draft Indicator/Focal Species", DVS = "Draft Vital Sign", DVS-R = "Draft Vital Sign – Rockfish"; Areas: total count of Geographic Areas (out of 14) where the species was observed on transects; Range: Range of site specific density values.; Mean CV: spatial Coefficient of Variation across Sites in an Geographic Area; Mean Freq. Occur.: Ratio of number of sites the species was observed on a transect in an Geographic Area, divided by the total number of sites in the Geographic Area.

Species	Common Name	MME Focal Type	Areas	Mean Density (No./100m^2)	Range	Mean CV	Mean Freq. Occur.
Centrostephanus coronatus	Coronado/crowned urchin	—	11	33.39	(0 - 764.5)	1.32	0.60
Haliotis corrugata	pink abalone	DVS	7	0.09	(0 - 1.9)	1.80	0.19
Haliotis fulgens	green abalone	DVS	5	0.26	(0 - 15.6)	2.13	0.20
Haliotis rufescens	red abalone	DVS	5	1.32	(0 - 22.8)	1.95	0.33
Kelletia kelletii	Kellet's whelk	DI/FS	13	3.26	(0 - 32.4)	1.11	0.74
Megastraea undosa	wavy turban snail	—	13	5.23	(0 - 68.1)	1.15	0.70
Megathura crenulata	giant key-hole limpet	DI/FS	14	2.95	(0 - 32.6)	1.08	0.81
Muricea californica	California golden gorgonian	—	11	12.04	(0 - 306.7)	1.28	0.76
Panulirus interruptus	spiny lobster	DVS	13	1.17	(0 - 48.1)	1.35	0.51
Parastichopus californicus	California sea cucumber	—	12	0.93	(0 - 73.1)	1.97	0.20
Parastichopus parvimensis	warty sea-cucumber	—	13	6.7	(0 - 96.8)	1.20	0.72
Pisaster brevispinus	short spined star	DI/FS	11	1	(0 - 19.4)	1.79	0.31
Pisaster giganteus	giant spined star	DI/FS	14	10.82	(0 - 70.4)	0.74	0.95
Pisaster ochraceus	ochre star	DI/FS	12	16.81	(0 - 221.1)	1.64	0.50
Pycnopodia helianthoides	sunflower star	DI/FS	10	1.87	(0 - 31.8)	1.51	0.56
Strongylocentrotus franciscanus	red urchin	DI/FS	14	132.51	(0 - 1545.7)	0.90	0.92
Strongylocentrotus purpuratus	purple urchin	DI/FS	14	311.72	(0 - 3673.8)	1.11	0.90
Styela montereyensis	stalked tunicate	—	10	10.47	(0 - 172.5)	1.47	0.61
Tethya californiana	orange puff-ball sponge	—	14	5.8	(0 - 40.8)	1.06	0.74

Generally, individual rockfish species also do not appear to have characteristics that would make them desirable indicator species across the entire SCSR (i.e., most occurred in relatively few Geographic Areas, had relatively higher CVs and lower frequencies of occurrence) (Table 1, see also plots for rockfishes in Appendix C). The exception may be Kelp Rockfish (*Sebastes atrovirens*) whose metrics were more similar to those of the good candidate indicator species mentioned above. Given the high spatial variability in abundance of these species and the extensive training necessary to identify most rockfishes to species, pooling all rockfish species together to create a single "Draft Vital Sign" metric in the SCSR Monitoring

Plan may appear to be a reasonable solution. However, due to the species-specific diversity of life history characteristics within this diverse group of fishes, particularly with respect to habitat use, growth patterns, trophic level and adult size structure (e.g., Echeverria 1987; Love et al. 1990; Love et al. 2003), a single value of "rockfish" abundance, and especially size frequency, will likely have little utility as an indicator from a management perspective and not be very informative to fishermen whose interests typically involve particular species.

A few of the invertebrate species evaluated here also appear to be good candidates for indicator species across most of the SCSR. The prime example is the Red Urchin (*Strongylocentrotus franciscanus*), one of the most valuable rocky reef fishery species, which occurs in every Geographic Area with a relatively high abundance and frequency of occurrence, and a relatively low spatial CV (Table 2; also see Appendix C, Figure C.41). These characteristics were also found for three of the emerging fishery species: Kellet's Whelk (*Kelletia kelletii*), Wavy Turban Snail (*Megastraea undosa*) and Giant Keyhole Limpet (*Megathura crenulata*) (also see respective figures in Appendix C). However, the California Spiny Lobster (*Panulirus interruptus*), while clearly one of the most important invertebrate fishery species from a commercial and recreational perspective, does have a relatively lower mean density and frequency of occurrence, because it is nocturnal, than many of the other species evaluated. The sea stars (*Pisaster spp*.) also present an interesting situation with the major die-off that has been occurring along the west coast of the U.S. over the past two years. The Baseline data collection in the SCSR occurred prior to any apparent large mortality events in the region and therefore the results reported here might not be reflective of what is observed in the next round of the long-term monitoring. The Giant Spined Star (*Pisaster giganteus*) had displayed the metrics of a good indicator species with the lowest spatial CV and the highest frequency of occurrence of any invertebrate, but this will likely no longer be the case.

Finally, as one would expect, the evaluated species with protected or endangered status, including Giant Sea Bass (*Stereolepis gigas*) and abalone (*Haliotis corrugata*, *H. fulgens*, *H. rufescens*) currently occur in relatively few Geographic Areas and generally have very low abundance and high spatial variability. Based on these metrics, they would not be good candidates to be used as indicator species across the entire SCSR as whole at their current abundance and distribution levels (Table 1, 2; also see respective figures in Appendix C). However, while still rare, using other metrics like presence/absence may be useful to monitor these species. Further, data from some Geographic Areas suggests these species are recovering (Appendix C, Figure D.26-D.28), and if this continues, they may become indicators that can be used more widely. Finally, given the strong environmental gradients that occur across the SCSR and the high degree of kelp forest community structure, these and other individual species will still be important to consider as indicator species in specific Geographic Areas for more fine spatial scale analyses of particular MPAs.

The sea star die-off and the protected/endangered species examples above highlight the challenges of identifying indicator species using a data-driven method where data may be limited in temporal scope. Identification of invasive species as indicators of ecosystem health poses equivalent challenges as these species may be absent or occur infrequently until they invade, at which point they may increase dramatically and quickly. While we advocate the use of data driven approaches to indicator selection to the maximum extent possible, we recognize potential limitations that can be filled in part by expert knowledge of the environment and species, or particular needs of managers. Finally, we reiterate that choice of specific indicator species or groups *must* be linked to the management or policy questions at hand. Identification of these questions will allow a better match between properties of an indicator (i.e., what exactly does the indicator indicate) and ultimately drive efficient and cost-effective monitoring.

Conclusions and Recommendations for Long-term Monitoring

Conclusion

The SCSR is characterized by strong environmental gradients (e.g., SST see Figure 1), a major defining feature of the SCSR compared to the other California MLPA Study Regions, which have relatively more spatially consistent physical environments. These differences are reflected biologically in a high degree of kelp forest community structure across the region. We identified 17 geographically cohesive community clusters, which we reduced to 14 Geographic Areas, each with distinct fish, invertebrate, and kelp assemblages (Figure 4-5). Structure was clearly related to sea surface temperature (Figure 6-10, see also Appendix B, Table B.1-B.5) and was driven by the distribution of focal species that were most abundant in either northern or southern parts of the SCSR (e.g., Figure 11-16).

Implication

The distribution of MPAs across the study region encompasses the biogeographic diversity of community structure within the kelp forest ecosystem. The differences found among Geographic Areas imply that monitoring results generated within a particular Geographic Area could only cautiously be extrapolated to MPAs in other Geographic Areas. Rather, long-term monitoring of MPAs should be distributed across the 14 distinct Geographic Areas. While this may be viewed as a somewhat 'atomistic' recommendation, because the SCSR comprises as much coastline and nearly as many MPAs as the remainder of the state combined, this still would result in less monitoring than what is currently being done for an equivalent amount of coastline in the rest of the state. Considering the substantial amount of effort that has been needed to properly understand these processes in the northern Channel Islands, annual monitoring at core sites within of these ecoregions is likely appropriate. Tradeoffs between spatial and temporal resolution in future kelp forest MPA monitoring programs remain to be investigated, but this study shows that a high degree of spatial resolution will be necessary to make general conclusion about MPA performance. In such a context, regional partnerships will likely be necessary.

Within the SCSR, the 14 statistically distinct Geographic Areas emphasize the challenge for understanding individual and global responses since they are likely to be more localized than responses observed in the other study regions in the state. The high spatial variability in physical oceanographic processes that create these biogeographic patterns can also result in differences in other biological response parameters, such as growth, recruitment and mortality rates, each of which can affect the trajectories of change inside and outside MPAs. For example, in the SCSR, California Sheephead (*Semicossyphus pulcher*) grow larger and faster in the parts of the region with lower sea surface temperatures (e.g., San Nicolas Island and the northern Channel islands) than in the warmer areas (e.g., Santa Catalina Island, San Clemente Island) (Hamilton et al. 2011). Therefore, over time it will be essential to maintain core monitoring sites in each of the Geographic Areas across the SCSR rather than use one Geographic Area as a proxy for others in the study region.

Additionally, by virtue of the high level of urbanization and year round fishing access, there is also variation in fishing and pollution pressure far beyond what has been observed elsewhere in the state. Many mainland SCSR rocky reefs experience extreme fishing pressure, a pattern that then generally declines with distance to the outer islands. Additionally, there is a similar gradient with respect to runoff. Greater local intensity of fishing before implementation should result in a greater magnitude MPA response over the long-term (Mangel 1998; Lester et al. 2009). In some cases increased biomass within MPAs has not been observed over short time scales (5–15 years) for some fished species (see species and location-specific examples in Hamilton et al. 2010). The lack of a short term recovery in some MPAs could result from transient and cyclical population dynamics post reserve implementation (White et al. 2013), although ultimately the speed of population recovery will be dependent largely on recruitment rates. The SCSR is characterized by highly variable recruitment (Caselle et al. 2010a; Caselle et al. 2010b), creating a need for annual observations in order to properly contextualize this system. A large recruitment event coupled with a release from the high fishing mortality should result in a rapid (5-10 yr) response in increased biomass. We are already starting to observe this response for rockfishes at Palos Verdes during our continued monitoring there in 2014. Conversely, periods of limited recruitment will slow the subsequent rate of biomass recovery.

Finally, episodic events and dynamic oceanography characterize the SCSR and further justify the need for annual monitoring. For example, for decades prior to and during reserve implementation, the south-facing reef inside Abalone Cove SMCA was characterized as an urchin barren. During the summer of 2014, our coastline was inundated with extreme southern swell events as a product of multiple hurricanes. These swell events were powerful enough to damage the federal breakwater at the Port of Long Beach. During our annual monitoring of this MPA, we observed that most urchins within this urchin barren were washed away by the event. However, if we were not surveying this reef annually, not only would we not understand the reason for the change, but we could have attributed the change to a positive 'reserve effect'. Theoretically, an accompanied increase in fish size and density, due to the reduction in fishing mortality, could have been assumed to be the source of the urchin removal. Taken together, the high spatial and temporal variability across the SCSR requires caution if trying to apply some 'lessons learned' from other study regions to this dynamic ecosystem.

Conclusion

The observed geographic patterns of community structure and similar habitat characteristics suggest that the reference areas identified during this baseline project were generally well matched with associated MPAs. A notable exception to the adequacy of reference areas is Begg Rock SMR, the offshore pinnacle reef with a unique community (Figure 4-5) and habitat characteristics (Figure 24). The originally proposed reference area to the Orange County MPAs (San Mateo Kelp, site no. 84 in Figure 3) also does not appear to be a suitable option.

Implication

With a few exceptions, these baseline reference areas seem appropriate for long-term monitoring studies. However, we assume that temporal dynamics of a reference area and associated MPA are similar, that is, track together in time. The baseline data are insufficient to test that assumption but continued monitoring would allow that test. For MPAs such as Begg Rock, without a suitable reference area, change over time may need to serve as the main approach to measure impacts. However, Cortez and Tanner Banks may also be appropriate references for Begg Rock (Figure 26). These areas are significant habitats for fisheries and endangered species (e.g., white abalone), and considering their unique location with respect to the Southern California Counter Current and the connectivity it affords (Hickey 1993), a better understanding of this offshore region may provide substantial insight into biological processes (e.g., recruitment, larval connectivity) for the SCSR. For the Orange County MPAs, only the middle section of this coastline (Laguna Beach SMR and SMCA) is no-take, with the types of fishing likely to impact subtidal kelp and rocky reef resources (e.g., commercial and recreational take of lobster and Red Urchin, recreational hook and line fishing) still permitted in the adjacent MPAs (Crystal

Cove SMCA and Dana Point SMCA). Therefore, Crystal Cove SMCA and Dana Point SMCA may be able to serve as appropriate “open” reference areas to Laguna Beach SMR when considering the species that are still being fished in those areas.

Conclusion

A reanalysis of the northern Channel Island kelp forest monitoring data through 2012 (NCI MPA network established in 2003) revealed: (1) more fish biomass inside the reserves compared to outside control areas for fish species targeted by fishing (Figure 31), (2) three of the five targeted invertebrate species in the rocky reef data (lobster, sea cucumber and Red Urchin) were more abundant inside reserves, (3) fished species biomass is increasing faster inside MPAs compared with the outside, where little change was observed over time (Figure 32), and (4) individual fished species all increased over time inside reserves while outside reserves, some increased, some decreased and some showed little change (Figure 33). Additionally, strong differences in biogeography and environmental conditions as well as natural fluctuations in highly dynamic temperate kelp forests complicate detection of reserve effects.

Implication

After 10 years of annual monitoring the NCI MPA network, clear “MPA Effects” were observable in targeted fish and invertebrate species. However, the life-history and population ecology of most kelp forest species would most likely require more than 6-12 months (the currently duration most new MPAs were monitored post implementation of the SCSR MPA Network) to exhibit a detectable response to the establishment of an MPA. Generally, we would not anticipate detectable changes in either community structure or metrics of species abundance (density or percent cover) or size that could be attributed to the establishment of the MPAs so soon (i.e., less than one year) after their establishment. Any “MPA effects” in these metrics that would be detected over this duration would most likely be spurious and not attributable to the presence of MPAs. Longer term monitoring will be necessary to detect these responses. The NCI dataset and analyses can be used as a guide for future monitoring decisions based on statistical power to detect reserve effects and to evaluate tradeoffs between spatial and temporal resolution in future monitoring programs.

Conclusion

Extraction of marine resources on nearshore rocky reefs in the SCSR varies significantly by industry (i.e., recreational or commercial fisheries), taxa, space and time.

Implication

Determining the relationship of this fishing pressure on community structure and how it may change with reserve implementation will be critical for understanding how these communities respond overtime. Generally we would expect a positive relationship between the level of fishing pressure at a given location and the magnitude of change (i.e., increase in abundance or size structure of specific targeted species) within the MPA once sufficient time has passed after that fishing effect is removed. Our findings indicate that fishing impacts are variable in taxonomic composition and spatially explicit. This establishes a unique experimental design, where variable types of extraction and their effects on reef health and resilience can be examined across reefs in the region. This study can be expanded to evaluate spatial patterns of harvest using the CDFW fishing block data across the entire State to provide this context to the other Study Regions.

Conclusion

There is potential water quality stress along the mainland based upon major point-source inputs of rivers and POTWs. There are undoubtedly also localized problems with storm drain runoff and other sources of localized plumes. While the deleterious effects of runoff have been described, a less well understood stressor is eutrophication, which may be particularly problematic on various spatial scales.

Implication

Any MPA monitoring scheme should continue to coordinate with resource agencies to describe these problems and develop solutions and recommendations (e.g., BMPs) for improving water quality. It will be helpful to expand the pollution studies to include smaller point source and non-point-source stressors. MPAs provide a potentially unique opportunity to assess the affects of water quality on kelp forest communities in the absence of resource extraction.

Conclusion

Our indicator species evaluation revealed that a handful of the candidate species might possess the wide spatial distribution and general statistical properties that would be characteristic of a good indicator for the entire SCSR. These included Kelp Bass (*Paralabrax clathratus*), California Sheephead (*Semicossyphus pulcher*), Red Urchin (*Strongylocentrotus franciscanus*), Kellet's Whelk (*Kelletia kelletii*), Wavy Turban Snail (*Megastraea undosa*) and Giant Key-hole Limpet (*Megathura crenulata*). These species occurred in all or most of the Geographic Areas with a relatively high abundance and frequency of occurrence, and a relatively low spatial coefficient of variation. Other species evaluated, such as all individual rockfish species, with the exception of Kelp Rockfish (*Sebastes atrovirens*), were more limited in their spatial distribution and generally did not possess desirable statistical properties. Given the strong environmental gradients that occur across the SCSR and the high degree of kelp forest community structure, most of the other candidates will only be appropriate to consider as indicator species for specific Geographic Areas within the SCSR for more fine spatial scale analyses of particular MPAs.

Implication

Results of this evaluation (Table 1-2) may be used to guide future analyses once a sufficient time has passed and sufficient data is available to assess the impacts of the MPAs across the SCSR Network. Community group or ‘Citizen Scientist’ monitoring programs in the SCSR may consider revising their monitoring protocols, which typically survey a more limited species list, to focus more effort on quantifying the species with more desirable indicator characteristics. Additionally, a single value of “rockfish” abundance (i.e., aggregating data across all rockfish species observed), and especially size frequency, will likely have little utility as an indicator from a management or stakeholder perspective. Finally, choice of specific indicator species or groups *must* be linked to the management or policy questions at hand. Identification of these questions will allow a better match between properties of an indicator (i.e., what exactly does the indicator indicate) and ultimately drive an efficient and cost-effective monitoring program.

Conclusion

While not detailed in the technical sections above, significant time and resources were spent in merging and synthesizing both new and existing datasets from the two kelp forest monitoring programs involved in this baseline project (PISCO and VRG), despite the fact that both groups had collaborated for many years and use very similar field protocols for data collection. Differences between programs in data storage, programming software preferences, QA/QC procedures, taxonomic and site coding, and analysis techniques required more effort than initially anticipated to create usable, documented datasets. A major accomplishment of this baseline project was the integration of each program's existing monitoring databases, and the integration of data from the two previous Southern California Bight-wide surveys (CRANE 2004 and Bight '08).

Implication

Future monitoring programs will almost certainly require partnerships and collaborations, from academic and agency scientists to citizen groups. To the extent possible, data management should be discussed from the beginning of any new program. In addition, adequate resources must be anticipated and budgeted for a partnership approach to result in high quality, defensible data. Merging datasets from multiple programs is challenging and takes time and expertise from researchers familiar with each dataset. This will especially be the case when merging data across ecosystem features and across Study Regions where even greater taxonomic and data structure differences will exist. One of the goals of the MLPA is ecosystem health, a goal that needs to be managed on various spatial and temporal scales. Therefore, despite the challenges associated with data integration, data synthesis across these larger scales (e.g., across ecosystem features and across Study Regions) is a truly novel opportunity presented by the California statewide network of MPAs and associated monitoring programs. Globally, this represents the best opportunity to date to discover how ecosystems and MPAs function at these large scales.

Partnerships

This project was only possible due to partnerships at several levels. The primary partnership was between the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) at UC Santa Barbara and the Vantuna Research Group (VRG) at Occidental College. These programs had collaborated closely on the development and implementation of previous monitoring efforts in the SCSR, including the Cooperative Assessment of Nearshore Ecosystems (CRANE '04) and the Bight '08 rocky reef monitoring programs. PISCO is a long-term ecosystem research and monitoring program established with the goals of understanding dynamics of the coastal ocean ecosystem along the U.S. west coast and sharing that knowledge so ocean managers and policy makers can make science based decisions regarding coastal and marine stewardship. In the SCSR, PISCO scientists work closely with the National Park Service Kelp Forest and Intertidal Monitoring programs, the Channel Islands National Marine Sanctuary (CINMS), as well as MARINe (Multi Agency Rocky Intertidal Network). Dr. Caselle, in partnership with CDFW, NPS and CINMS was a lead scientist on the 5-year and 10-year evaluations of the Channel Islands MPA network. The VRG has been studying nearshore SCSR rocky reefs since the mid-1960s. Dr. Pondella led the Bight '08 Rocky Reef Program and developed and oversees the Santa Monica Bay Restoration Commission's (SMBRC) Rocky Reef Monitoring Program that includes the rocky reefs from Malibu (Los Angeles/Ventura County Line) to Pt. Fermin, Palos Verdes. This collaborative effort also features the ongoing collaboration of The Bay Foundation's marine research program, Los Angeles County Sanitation District's (LACSD) research arm, and Los Angeles Waterkeeper's Kelp Restoration Program. Currently these four research programs are working collaboratively on kelp bed restoration projects and reef monitoring along the Palos Verdes coastline. Much of this research is currently being funded by NOAA's Montrose Settlements Restoration Program (MSRP) on the Palos Verdes Shelf. In addition, funding for sampling at San Clemente Island and analyses was provided by the US Navy. The integration among these programs led to the successful inclusion of rocky reef studies in the Southern California Coastal Water Research Project's (SCCWRP) Bight Program led by Ken Schiff which greatly enhances the resources needed to address water quality issues on small and large scales throughout the Southern California Bight.

The PISCO and VRG partnership was extremely successful. Strong collaboration made it possible to sample 75 sites in 2011 and 88 sites 2012 from across the 1197.2 km of coastline in the SCSR using almost identical protocols. PISCO conducted the surveys of sites from Malibu to the northern border of the SCSR, while the VRG surveyed sites from Palos Verdes to the southern border of the SCSR, including sites at all of the respective offshore islands in both cases. Another major accomplishment of this partnership was the integration of each program's existing monitoring databases, and the integration of data from the two previous Southern California Bight-wide surveys (CRANE 2004 and Bight '08). Given the taxonomic complexity (i.e., fishes, invertebrates and algae), the multiple data/survey types (e.g., fish transects, benthic swath transect, benthic cover and habitat characteristics, invertebrate size structure), differences in the database structure and preferred software coding of each program, and the various program-specific intricacies of data processing and formatting, this was a much larger task than originally anticipated. We now also have code written in both R and SAS that can automate much of the QA/QC and data translation process when adding data from future long term monitoring efforts. Moving forward this integrated data base will prove to be an extremely valuable product of the Baseline project, permitting us to answer important ecological questions over a much larger spatial and temporal scale than previously thought possible. One of the goals of the MLPA is ecosystem health, a goal that needs to be managed on various spatial and temporal scales. In the obviously complex rocky-reef environment of the SCSR, we have developed and maintained a program that can answer questions in various dimensions that will facilitate the understanding of processes related to the condition of this ecosystem.

In the past, currently and in the future, the strong partnership with SCCWRP and their 'Bight' programs is essential for the continued success of this program. Two major themes presented herein (fishing and pollution pressure) are significant components beyond what has been needed or developed in the other study regions. This program, led by Steve Weisberg and Ken Schiff, has been invaluable for the development of process understanding and solutions for the SCSR. (For more information on the Bight '13 project see http://bit.ly/1sDQopT).

This baseline project is also related to another rocky reef monitoring project undertaken by Reef Check CA (RCCA), a citizen science program dedicated to involving citizen divers in reef monitoring. RCCA is well positioned as an outlet for enhanced citizen involvement and outreach related to the SCSR MPA network. As a relatively new organization, RCCA developed survey protocols for nearshore rocky reef ecosystems modeled after those used by PISCO and VRG. While less taxonomically diverse than ours, RCCA protocols were designed to 'nest' in our methods (Gillett et al. 2012). During the SCSR Baseline program, data collection, storage and dissemination activities were all maintained separately for RCCA and this project. However, the lead dive technician at UCSB is heavily involved with RCCA and is a trainer for their programs. As such, he provided detailed knowledge of differences and similarities in the field data collections. Results presented here (see Candidate Indicator Species Evaluation section) may provide additional guidance for refining RCCA protocols in the SCSR. Future collaborations involving additional calibration studies, such as those completed in 2010 (Gillett et al. 2012), would further increase our understanding of the capacity of RCCA data relative to those collected by professional scientists.

Integration

The concept of Ecosystem Based Management is rooted in this holistic view of ecosystems, the idea that ecosystems should be adaptively managed, and that decision-making should be informed by the best available scientific information. These ideas lie at the heart of the monitoring and management plans for one of the newest and largest networks of marine protected areas in the world. The 1999 California Marine Life Protection Act (MLPA) led to the establishment of a network of Marine Protected Areas (MPAs) across the state of California. The MLPA requires monitoring to inform adaptive management of MPAs by measuring performance relative to the goals of the Act. Meeting the requirements of the MLPA means taking an ecosystems approach to monitoring in which ecosystems are the top level of the monitoring hierarchy and provide the umbrella that encompasses species, populations, habitats and humans. Although many marine habitats and their constituent communities have been extensively studied along the coast of California (e.g. kelp forest, rocky intertidal), studies of how these habitats are linked via species (e.g. birds, fish) that utilize multiple habitats within the ecosystem are rare. Information about the non-consumptive roles of humans in these coastal ecosystems is also relatively lacking, particularly in the context of how these systems might best be monitored in the future to meet a broad array of goals.

Here we provide a brief summary of the areas in which data from our South Coast Kelp and Shallow Rock Ecosystems Baseline Project are being used to address integrative issues, beyond kelp forest ecosystems, and involving data collection across other South Coast MPA Baseline Projects.

1. Biogeographic patterns of communities across multiple marine ecosystems in southern California

Jeremy Claisse, Carol Blanchette, Jennifer E. Caselle , Jonathan P. Williams, Daniel J. Pondella, Laurel A. Zahn, Chelsea M. Williams, Jenifer Dugan, James Lindholm, Ashley Knight, Dan Robinette, Meredith Elliott, Rani Gaddam, Katie Davis

With the implementation of ecosystem based management approaches becoming more common, broad scale questions are increasingly dominant in conservation and management, requiring marine ecologists to examine linkages between patterns and processes operating at large spatial scales across ecosystems. The Southern California Bight is a complex biogeographic region as it is a transitional zone between the cold temperate fauna fueled by the California Current to the north and the warm temperate fauna from the south. A large scale sampling effort in 2011 and 2012 created a novel opportunity to compare patterns in community structure across multiple community and ecosystem types. Here we used non-metric multidimensional scaling analyses to quantify spatial patterns of community structures in eight different community types (rocky intertidal invertebrates, sandy beach invertebrates, shorebirds, kelp forest fishes, kelp forest invertebrates, deep water fishes, deep water benthic invertebrates, juvenile fishes indexed through Least Tern diet), which inhabit multiple marine ecosystems across this region. We found a high degree of spatial structure in the similarity within and across these communities. Patterns related to the complex environmental gradients that occur across the region, but key differences were revealed among some community types, which have important implications for the scales at which they are managed.

2. Citizen science monitoring of marine protected areas: case studies and recommendations for integration for among monitoring programs

Jan Friewald, Jennifer Caselle, Ryan Meyer, Doug Neilson, Kevin Hovel, Dina Liebowitz, Carol Blanchette, Jenny Dugan, and Julie Bursek

Ecosystem-based management and conservation approaches such as marine protected areas (MPAs) require large amounts of ecological data to be implemented, adaptively managed towards their goals and in order to evaluate their achievements or failures. Implementation of MPAs under the Marine Life Protection Act (MLPA) Initiative in southern California was followed by a monitoring program to establish a comprehensive baseline of marine ecosystems at the time of MPA implementation. The baseline monitoring consortium involved several citizen science monitoring programs alongside more traditional academic monitoring programs. We are investigating different citizen science models and their program goals with respect to their involvement in MPA baseline monitoring and examine their respective monitoring protocols and data quality assurance measures in light of the goals of the MLPA baseline monitoring program. We focus on three case studies: volunteer divers monitoring rocky reefs with the Reef Check California (RCCA) program, high school students monitoring rocky intertidal and sandy beach ecosystems with the LIMPETS program, and commercial fishermen and other volunteers collaborating with researchers to study the California spiny lobster. Through analysis of the experiences from each of these very different projects, and drawing on broader literature focused on citizen science, we elucidate capacities and potential of citizen science approaches for MPA baseline monitoring and for building capacity towards sustainable long-term monitoring of MPAs. In two of the three cases, comparison with academic monitoring programs surveying the same ecosystems, kelp forests and rocky intertidal, will inform recommendations for best practices for citizen science MPA monitoring and the creation of a framework of what types of monitoring questions can be addressed by citizen science. Results from this study will be relevant and timely as the monitoring of California's MPAs transitions from baseline to long-term monitoring, and as citizen science continues to become more prevalent in California and elsewhere in marine ecosystem monitoring.

3. Can nearshore foraging seabirds detect variability in juvenile fish distribution inside and outside of marine reserves

Daniel P. Robinette, Julie Howar, Jennifer E. Caselle, Jeremy Claisse

California's Marine Life Protection Act established a network of marine protected areas (MPAs) throughout the state. As these MPAs mature, there will be a need not only to detect change in several levels of community structure, but to also establish efficiencies among monitoring programs to maximize coverage throughout the state. Juvenile recruitment is an important determinant of change within MPAs. Understanding spatio-temporal variability in recruitment rates will help managers set realistic expectations for individual MPAs and the network as a whole. Here we ask whether seabird foraging distributions can be used as a proxy for juvenile fish recruitment inside and outside of MPAs in southern California. We investigated the foraging distributions of five piscivorous seabirds during April-August of 2012 and 2013. We conducted weekly foraging surveys at plots inside and outside of three island and three coastal marine reserves. Additionally, we estimated juvenile fish abundance using data from diver surveys conducted at the same sites in the same years. We will integrate these data with regional measures of oceanographic productivity (e.g., upwelling, sea surface temperature) and larval fish abundance to assess seabird responses to spatio-temporal variability in fish recruitment. Past studies have shown that seabird diet, seabird foraging rates, and juvenile fish abundance respond to variability in regional upwelling and larval fish abundance, with localized effects influenced by coastal geographic features such as promontories that impact larval delivery to nearshore habitats. These results suggest that seabird studies can help resource managers understand local patterns of fish recruitment and establish realistic expectations for how quickly fish populations should change within individual MPAs.

4. Ontogenetic patterns in demersal fish-habitat associations off southern California

Jeremy Claisse, Jennifer Caselle, James Lindholm, Ashley Knight, Jonathan Williams, Jan Friewald, Daniel J. Pondella, Laurel A. Zahn, Chelsea M. Williams, and Katie Davis

As fishes grow, their ability to use resources and the manner in which they interact with others changes, resulting in ontogenetic changes in their patterns of habitat use. Here we combined data from two large scale survey efforts across the Southern California Bight in 2011 and 2012: shallow water SCUBA surveys conducted at 94 sites at depths of 3 to 30 m with deep water ROV surveys conducted at multiple deeper sites. These data reveal ontogenetic shifts in habitat use in multiple fishes, primarily rockfish species (genus *Sebastes*), which are also important to commercial and recreational fisheries. Generally, smaller (younger) individuals were observed in more shallow waters, whereas larger (older) individuals tend to be found in deeper habitats. By combining data from these two sampling methods, we gain a more complete picture of the existing size structure of these fishes, an important metric when evaluating population status and effectiveness of management actions.

5. Drift kelp links subtidal and beach ecosystems in southern California

Jenifer Dugan, David Hubbard, Jeremy Claisse, Jennifer E. Caselle, Jonathan P. Williams, Nicholas Schooler, Jan Friewald

An understanding of connectivity and exchanges between ecosystems and how resource variability affects consumers is needed for predicting community and food web responses to environmental change and management actions, such as MPA establishment. Highly productive kelp forest ecosystems are characterized by large temporal variation in net primary production (NPP), and > 90% of kelp NPP is exported. Sandy beach ecosystems near kelp forests depend heavily on this drift kelp (wrack) to support diverse food webs including avian predators. This paper will explore and seek to quantify critical links between kelp forest and sandy beach ecosystems dynamics in southern California

6. A synthesis of range extensions, rarities, invasive species encounters, and unique occurrences in the Southern California Bight as a product of South Coast MPA Baseline Monitoring projects

Jonathan P. Williams, Jennifer Caselle et al.

The Southern California Bight (SCB) spans a significant environmental gradient and is subject to the influx and removal of species based upon subtle regional changes as well as large-scale changes in climate and oceanographic conditions. Past reports of new or unusual species to the SCB were typically a product of large-scale oceanographic phenomena such as El Niño/Southern Oscillation events, increases in invasive species vectors through port expansion, new technologies, and stocking efforts, or simply a product of motive and opportunity. The opportunity to observe and document a unique or rare species across the entirety of the Bight presented itself with the establishment of marine protected areas (MPAs) in southern California and the subsequent baseline monitoring program for those newly established MPAs. Here we describe range extensions and unique occurrences of several species of marine fish, invertebrates, algae and birds as observed during the 2011-2012 South Coast MPA Baseline Program as well as other recent monitoring efforts.

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Baseline Characterization of the Shallow Rocky Reef and Kelp Forest Ecosystems of the South Coast Study Region: Table and Figure Appendices

Appendix A

Appendix B

Appendix C

Appendix D

Appendix E

Appendix F

Appendix G

Appendix H

Appendix A

Table A.1. Kelp and shallow rock ecosystem sites sampled as part of the SCSR MPA Baseline Monitoring Program (2011 & 2012) and in the historical database (2004 & 2008). Sites sampled during the MPA Baseline Monitoring Program are also numbered and the numbers appear in other figures throughout the report.

Site	Latitude	Longitude	MPA	Status	Site #	2004	2008	2011	2012
SMI - Cuyler	34.05405	-120.35042	Harris Point SMR	Reference	1	x	x	x	x
SMI - Harris Point Reserve	34.05986	-120.35069	Harris Point SMR	MPA	2	x	x	x	x
SMI - Crook Point	34.01647	-120.33518	Harris Point SMR	Reference	3	x	x	x	x
SMI - Tyler Bight	34.02714	-120.40928	Harris Point SMR	Reference	4	x	x	x	x
SRI - Rodes Reef	34.03123	-120.11136	Carrington Point SMR	Reference	—	x	x	—	—
SRI - Beacon Reef	34.04058	-120.04733	Carrington Point SMR	MPA	—	x	x	—	—
SRI - Monacos	33.98455	-120.01325	Carrington Point SMR	Reference	—	x	x	—	—
SRI - Jolla Vieja	33.90769	-120.06770	South Point SMR	Reference	—	x	x	—	—
SRI - Johnson's Lee North	33.90198	-120.10135	South Point SMR	Reference	—	—	x	—	—
SRI - Johnson's Lee South	33.89726	-120.10359	South Point SMR	Reference	5	x	x	x	x
SRI - South Point	33.89344	-120.12148	South Point SMR	MPA	6	—	x	x	x
SRI - Chickasaw	33.90070	-120.13751	South Point SMR	MPA	—	x	x	—	—
SRI - Trancion Canyon	33.90725	-120.15300	South Point SMR	MPA	—	—	x	—	—
SRI - Cluster Point	33.92908	-120.19083	South Point SMR	Reference	7	x	x	x	x
SRI - Bee Rock	33.95390	-120.21190	South Point SMR	Reference	—	x	x	—	—
SCRI - Painted Cave	34.07297	-119.87009	Painted Cave SMCA	MPA	8	x	x	x	x
SCRI - Hazards	34.05645	-119.82174	Painted Cave SMCA	Reference	9	x	x	x	x
SCRI - Pelican	34.03166	-119.69668	Scorpion SMR	Reference	10	x	x	x	x
SCRI - Coche Point	34.04387	-119.60290	Scorpion SMR	Reference	11	x	x	x	x
SCRI - Potato Pasture	34.05098	-119.57588	Scorpion SMR	MPA	—	—	x	—	—
SCRI - Cavern Point	34.05384	-119.56949	Scorpion SMR	MPA	12	—	x	x	x
SCRI - Scorpion	34.05032	-119.55051	Scorpion SMR	MPA	13	x	x	x	x
SCRI - Little Scorpion	34.04340	-119.53573	Scorpion SMR	Reference	—	—	x	—	—
SCRI - San Pedro Point	34.03837	-119.52530	Scorpion SMR	Reference	—	—	x	—	—

Table A.1. (continued) Kelp and shallow rock ecosystem sites sampled as part of the SCSR MPA Baseline Monitoring Program (2011 & 2012) and in the historical database (2004 & 2008). Sites sampled during the MPA Baseline Monitoring Program are also numbered and the numbers appear in other figures throughout the report.

Site	Latitude	Longitude	MPA	Status	Site #	2004	2008	2011	2012
SCRI - Yellowbanks	33.99283	-119.55903	Gull Island SMR	Reference	14	x	x	x	x
SCRI - Valley	33.98320	-119.64183	Gull Island SMR	Reference	15	x	x	x	x
SCRI - Gull Island	33.94833	-119.82489	Gull Island SMR	MPA	16	x	x	x	x
SCRI - Forney	34.05358	-119.91427	Painted Cave SMCA	Reference	17	x	x	x	x
AI - West Isle	34.01693	-119.43079	Anacapa Island SMCA	MPA	18	x	x	x	x
AI - Middle Isle	34.00862	-119.39041	Anacapa Island SMR	MPA	19	x	x	x	x
AI - Black Seabass Reef	34.01268	-119.38892	Anacapa Island SMR	MPA	—	x	—	x	x
AI - East Isle	34.01672	-119.36571	Anacapa Island SMR	MPA	20	x	x	x	x
AI - Lighthouse Reef	34.01237	-119.36510	Anacapa Island SMR	Reference	21	x	x	x	x
AI - East Fish Camp	34.00158	-119.39807	Anacapa Island SMR	Reference	—	—	x	—	—
AI - Admiral's Reef	34.00350	-119.42410	Anacapa Island SMCA	Reference	—	—	x	—	—
SNI - Begg Rock	33.36237	-119.69495	Begg Rock SMR	MPA	22	—	x	—	x
SNI - Sand Spit	33.21965	-119.43422	—	—	—	x	x	—	—
SNI - Station 1	33.21282	-119.46856	—	—	—	x	—	—	—
SNI - Dutch Harbor	33.21563	-119.48368	—	—	—	—	x	—	—
SNI - Aerolight	33.22000	-119.50782	—	—	—	—	x	—	—
SNI - Cormorant Rock	33.25027	-119.58617	—	—	—	—	x	—	—
SNI - Boilers	33.27600	-119.60693	—	—	23	—	—	—	x
SBI - Arch Point	33.48911	-119.02785	Santa Barbara Island SMR	Reference	—	x	x	—	—
SBI - Graveyard Canyon	33.47471	-119.02679	Santa Barbara Island SMR	MPA	24	—	x	x	—
SBI - Southeast Sealion	33.46878	-119.02882	Santa Barbara Island SMR	MPA	25	x	x	x	x
SBI - Southeast Reef	33.46293	-119.03127	Santa Barbara Island SMR	MPA	26	—	x	—	x
SBI - Cat Canyon	33.46442	-119.04408	Santa Barbara Island SMR	Reference	27	—	x	x	—
SBI - Sutil	33.46585	-119.04821	Santa Barbara Island SMR	Reference	28	—	x	x	x

Table A.1. (continued) Kelp and shallow rock ecosystem sites sampled as part of the SCSR MPA Baseline Monitoring Program (2011 & 2012) and in the historical database (2004 & 2008). Sites sampled during the MPA Baseline Monitoring Program are also numbered and the numbers appear in other figures throughout the report.

Site	Latitude	Longitude	MPA	Status	Site #	2004	2008	2011	2012
SBI - Webster's Arch	33.47910	-119.05250	Santa Barbara Island SMR	Reference	—	—	x	—	—
SCAI - Johnson's Rocks	33.47608	-118.58914	Arrow Point to Lion Head Point SMCA	MPA	—	x	—	—	—
SCAI - Indian Rock	33.46887	-118.52617	Arrow Point to Lion Head Point SMCA	MPA	29	—	—	x	x
SCAI - Lion Head	33.45387	-118.50253	Arrow Point to Lion Head Point SMCA	MPA	—	—	x	—	—
SCAI - Ship Rock	33.46302	-118.49140	Blue Cavern SMCA	Reference	30	—	—	x	x
SCAI - Isthmus Reef	33.44782	-118.48932	—	—	—	x	—	—	—
SCAI - Bird Rock	33.45217	-118.48767	Blue Cavern SMCA	MPA	31	—	—	x	x
SCAI - Intake Pipes	33.44708	-118.48510	Blue Cavern SMCA	MPA	—	x	—	—	—
SCAI - Blue Cavern	33.44802	-118.47947	Blue Cavern SMCA	MPA	32	—	—	x	x
SCAI - West Quarry	33.44250	-118.47017	Blue Cavern SMCA	MPA	33	x	—	x	—
SCAI - Ripper's Cove	33.42815	-118.43547	Blue Cavern SMCA	Reference	34	x	x	x	x
SCAI - Twin Rocks	33.41788	-118.38917	Long Point SMR	MPA	35	—	—	—	x
SCAI - Italian Gardens	33.41073	-118.37576	Long Point SMR	MPA	36	—	—	x	—
SCAI - Hen Rock	33.40010	-118.36690	Long Point SMR	Reference	37	—	—	x	x
SCAI - Lover's Cove	33.34358	-118.31705	Lover's Cove SMCA	MPA	38	—	—	x	x
SCAI - East Quarry	33.31926	-118.30333	—	—	—	x	x	—	—
SCAI - Salta Verde	33.31458	-118.42152	Farnsworth Onshore SMCA	Reference	39	—	—	x	x
SCAI - China Point	33.33032	-118.46975	Farnsworth Onshore SMCA	MPA	40	—	—	x	x
SCAI - Indian Head	33.37990	-118.48205	—	—	—	—	x	—	—
SCAI - Fred Rock	33.38925	-118.48088	—	—	—	x	—	—	—
SCAI - Banana Rock	33.39990	-118.48630	—	—	—	—	x	—	—
SCAI - Pin Rock	33.42352	-118.50433	—	—	—	x	—	—	—
SCAI - Cat Harbor	33.42609	-118.51181	Cat Harbor SMCA	MPA	41	x	—	x	x
SCAI - Lobster Bay	33.42760	-118.52032	—	—	—	x	—	—	—

Table A.1. (continued) Kelp and shallow rock ecosystem sites sampled as part of the SCSR MPA Baseline Monitoring Program (2011 & 2012) and in the historical database (2004 & 2008). Sites sampled during the MPA Baseline Monitoring Program are also numbered and the numbers appear in other figures throughout the report.

Site	Latitude	Longitude	MPA	Status	Site #	2004	2008	2011	2012
SCAI - Iron Bound Cove	33.44750	-118.57515	Cat Harbor SMCA	Reference	42	—	x	x	x
SCAI - West Kelp	33.47219	-118.60310	—	—	—	x	—	—	—
SCLI - Castle Rock	33.03732	-118.61528	SWAT 1	MPA	43	—	—	—	x
SCLI - Northwest Harbor	33.03225	-118.58382	—	—	44	—	—	—	x
SCLI - Reflector Reef	33.02639	-118.56347	—	—	45	—	—	—	x
SCLI - Boy Scout Camp	33.00208	-118.54826	Wilson Cove	MPA	46	—	—	—	x
SCLI - Station 1	32.93640	-118.49825	Wilson Cove	Reference	47	—	—	—	x
SCLI - Purseseine Rock	32.86900	-118.41043	Wilson Cove	Reference	48	—	—	—	x
SCLI - Lil Flower	32.83663	-118.36587	—	—	49	x	x	x	x
SCLI - Pyramid Cove	32.81550	-118.37115	—	—	50	x	x	x	x
SCLI - China Point	32.80065	-118.42918	—	—	51	x	x	—	x
SCLI - Lost Point	32.84186	-118.49016	—	—	52	—	—	—	x
SCLI - Eel Point	32.90469	-118.53910	—	—	53	—	—	—	x
SCLI - South Range	32.96762	-118.57756	SWAT 1	Reference	54	—	—	—	x
Cojo	34.44435	-120.41927	—	—	55	x	x	x	x
Bullito	34.45683	-120.33170	—	—	56	—	—	x	x
Arroyo Quemado	34.46804	-120.12116	Naples SMCA	Reference	57	—	—	x	x
Naples	34.42353	-119.95266	Naples SMCA	MPA	58	x	x	x	x
IV Reef	34.40401	-119.86915	Campus Point SMCA	MPA	59	—	—	x	x
Lead Better Beach	34.39676	-119.69829	—	—	—	—	x	—	—
Carp Reef	34.41762	-119.60512	—	—	—	—	x	—	—
Horseshoe Reef	34.39166	-119.55003	—	—	60	—	—	x	x
Deep Hole East	34.04522	-118.95920	—	—	61	—	x	x	x

Table A.1. (continued) Kelp and shallow rock ecosystem sites sampled as part of the SCSR MPA Baseline Monitoring Program (2011 & 2012) and in the historical database (2004 & 2008). Sites sampled during the MPA Baseline Monitoring Program are also numbered and the numbers appear in other figures throughout the report.

Site	Latitude	Longitude	MPA	Status	Site #	2004	2008	2011	2012
Leo Carrillo East	34.03996	-118.92427	Point Dume SMR	Reference	62	—	x	x	x
Nicholas Canyon West	34.03811	-118.91251	—	—	—	—	x	—	—
Encinal Canyon East	34.03505	-118.87098	Point Dume SMCA	MPA	63	—	—	x	x
Point Dume	33.99884	-118.80659	Point Dume SMR	MPA	64	—	x	x	x
Little Dume West	34.00654	-118.79097	Point Dume SMR	MPA	65	—	x	x	x
Escondido West	34.02029	-118.77356	—	—	—	—	x	—	—
Malibu Bluffs	34.02825	-118.70594	—	—	—	x	—	—	—
Big Rock	34.03536	-118.60776	—	—	—	—	x	—	—
Flat Rock North	33.80147	-118.40779	—	—	—	—	x	—	—
Ridges North	33.78848	-118.42323	Point Vicente SMCA	Reference	66	—	—	x	x
Ridges South	33.78631	-118.42641	Point Vicente SMCA	Reference	67	—	x	—	x
Rocky Point North	33.78093	-118.42999	Point Vicente SMCA	Reference	68	x	x	x	x
Rocky Point South	33.77638	-118.43160	Point Vicente SMCA	Reference	69	—	—	x	x
Lunada Bay	33.77180	-118.43030	—	—	70	—	—	x	x
Resort Point	33.76650	-118.42742	—	—	71	—	x	—	x
Underwater Arch	33.75144	-118.41655	—	—	72	—	—	—	x
Hawthorne Reef	33.74662	-118.41657	Point Vicente SMCA	Reference	73	—	—	x	x
Point Vicente West	33.73974	-118.41369	Point Vicente SMCA	MPA	74	x	x	x	x
Long Point East	33.73595	-118.40122	Point Vicente SMCA	MPA	75	—	—	x	x
Abalone Cove Kelp West	33.73922	-118.38789	Abalone Cove SMCA	MPA	76	—	—	x	x
Bunker Point	33.72465	-118.35317	Abalone Cove SMCA	Reference	77	—	—	x	x
3 Palms East	33.71762	-118.33215	—	—	—	—	x	—	—
Whites Point	33.71531	-118.32486	—	—	78	—	x	x	x
Point Fermin	33.70667	-118.29928	—	—	79	—	x	x	x

Table A.1. (continued) Kelp and shallow rock ecosystem sites sampled as part of the SCSR MPA Baseline Monitoring Program (2011 & 2012) and in the historical database (2004 & 2008). Sites sampled during the MPA Baseline Monitoring Program are also numbered and the numbers appear in other figures throughout the report.

Site	Latitude	Longitude	MPA	Status	Site #	2004	2008	2011	2012
Little Corona	33.58419	-117.86545	Crystal Cove SMCA	MPA	—	—	x	—	—
Crystal Cove	33.56275	-117.83770	Crystal Cove SMCA	MPA	80	—	x	x	x
Heisler Park	33.54039	-117.79189	Laguna Beach SMR	MPA	81	—	x	—	x
Laguna Beach	33.53115	-117.78048	Laguna Beach SMR	MPA	82	—	—	x	—
Dana Point	33.46160	-117.72145	Dana Point SMCA	MPA	83	x	—	x	x
San Mateo Kelp	33.36900	-117.61058	—	—	84	x	—	x	x
San Onofre	33.34445	-117.55735	—	—	—	x	—	—	—
Barn Kelp	33.29240	-117.48751	—	—	—	x	x	—	—
Carlsbad	33.12792	-117.33693	—	—	—	x	—	—	—
South Carlsbad	33.09845	-117.32315	—	—	85	—	—	x	—
Leucadia	33.06360	-117.30932	Swami's SMCA	Reference	86	—	—	x	x
Encinitas	33.03408	-117.29655	Swami's SMCA	MPA	—	x	—	—	—
Swami's	33.03574	-117.30134	Swami's SMCA	MPA	87	—	—	—	x
San Elijo	33.01818	-117.28882	Swami's SMCA	MPA	88	—	—	x	—
Cardiff	32.99540	-117.27813	—	—	—	x	—	—	—
Matlahuayl	32.85116	-117.27018	Matlahuayl SMR	MPA	89	—	—	x	x
Children's Pool	32.85167	-117.27829	Matlahuayl SMR	Reference	90	—	—	x	x
La Jolla	32.82952	-117.28815	—	—	—	—	x	—	—
South La Jolla	32.81593	-117.28372	South La Jolla SMR	MPA	91	x	—	x	x
Point Loma North	32.72434	-117.27689	—	—	—	x	x	—	—
Point Loma Central	32.71210	-117.26302	South La Jolla SMR	Reference	92	—	—	x	x
Point Loma South	32.67649	-117.25615	Cabrillo SMR	Reference	93	x	x	—	x
Cabrillo National Monument	32.66371	-117.24424	Cabrillo SMR	MPA	94	—	—	x	x
Total						**59**	**79**	**75**	**88**

Appendix B

Table B.1. PERMANOVA and BestaDispter (test for homogeneity of multivariate dispersions) results for fish (numerical density) community structure among Geographic Areas (Region). If there are significant differences in the multivariate dispersions among sites within Geographic Areas then PERMANOVA results should be interpreted with additional caution. However, in this case only a few pairwise BetaDisper comparisons were significant. Values below are the PERMANOVA R^2 statistics from pairwise tests of significant differences in community structure. Statistically significant values are indicated by * [Pr(>F) < 0.05] and ** [Pr(>F) < 0.005]. Tests were run using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each site.

PERMANOVA (adonis in R)						
	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Region	11	6.126	0.557	7.873	0.520	0.001
Residuals	80	5.659	0.071		0.480	
Total	91	11.785			1.000	
BetaDisper Test						
	Df	SumsOfSqs	MeanSqs	F	N.Perm	Pr(>F)
Groups	11	0.137	0.012	3.097	999	0.004
Residuals	80	0.323	0.004			
Tukey HSD (alpha = 0.05) Significant Pariwise BetaDisper Comparisons						
Regions	p_adj					
Orange and North County-Santa Cruz Island	0.04					
Orange and North County-Anacapa Island	0.001					
La Jolla and Point Loma-Orange and North County	0.045					

Region	San Miguel Island	Santa Rosa Island	Santa Cruz Island	Anacapa Island	Santa Barbara Island	Santa Catalina Island	San Clemente Island	Santa Barbara County	Malibu	Palos Verdes	Orange and North County
Santa Rosa Island	0.15										
Santa Cruz Island	0.4**	0.28**									
Anacapa Island	0.64*	0.63*	0.15*								
Santa Barbara Island	0.6*	0.54*	0.36**	0.31*							
Santa Catalina Island	0.55**	0.45**	0.37**	0.19**	0.25**						
San Clemente Island	0.6**	0.51**	0.4**	0.27**	0.28**	0.06					
Santa Barbara County	0.41*	0.32*	0.33**	0.46**	0.54**	0.5**	0.54**				
Malibu	0.56*	0.49*	0.21**	0.44*	0.53*	0.38**	0.43**	0.25**			
Palos Verdes	0.44**	0.29**	0.22**	0.18**	0.27**	0.3**	0.3**	0.27**	0.17**		
Orange and North County	0.5**	0.4*	0.36**	0.31**	0.39**	0.28**	0.3**	0.29**	0.23**	0.15**	
La Jolla and Point Loma	0.64*	0.55*	0.31**	0.41*	0.42**	0.25**	0.29**	0.39**	0.32**	0.11*	0.13*

Table B.2. PERMANOVA and BestaDispter (test for homogeneity of multivariate dispersions) results for fish (Biomass) community structure among Geographic Areas (Region). If there are significant differences in the multivariate dispersions among sites within Geographic Areas then PERMANOVA results should be interpreted with additional caution. However, in this case only one pairwise BetaDisper comparison was significant. Values below are the PERMANOVA R^2 statistics from pairwise tests of significant differences in community structure. Statistically significant values are indicated by * [Pr(>F) < 0.05] and ** [Pr(>F) < 0.005]. Tests were run using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each site.

PERMANOVA (adonis in R)						
	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Region	11	6.439	0.585	7.078	0.493	0.001
Residuals	80	6.616	0.083		0.507	
Total	91	13.055			1.000	
BetaDisper Test						
	Df	SumsOfSqs	MeanSqs	F	N.Perm	Pr(>F)
Groups	11	0.149	0.014	2.547	999	0.013
Residuals	80	0.426	0.005			
Tukey HSD (alpha = 0.05) Significant Pariwise BetaDisper Comparisons						
Regions	p_adj					
Orange and North County-San Clemente Island	0.043					

Region	San Miguel Island	Santa Rosa Island	Santa Cruz Island	Anacapa Island	Santa Barbara Island	Santa Catalina Island	San Clemente Island	Santa Barbara County	Malibu	Palos Verdes	Orange and North County
Santa Rosa Island	0.19										
Santa Cruz Island	0.41**	0.29*									
Anacapa Island	0.64*	0.61*	0.11								
Santa Barbara Island	0.57*	0.48*	0.33**	0.3*							
Santa Catalina Island	0.53**	0.41**	0.32**	0.15**	0.17**						
San Clemente Island	0.66**	0.54**	0.39**	0.27**	0.22**	0.08*					
Santa Barbara County	0.4*	0.34*	0.33**	0.44*	0.47**	0.45**	0.54**				
Malibu	0.56*	0.48*	0.21**	0.4*	0.49*	0.38**	0.49**	0.26**			
Palos Verdes	0.39**	0.27**	0.27**	0.2**	0.2**	0.23**	0.28**	0.24**	0.23**		
Orange and North County	0.51**	0.41*	0.41**	0.34**	0.3**	0.24**	0.33**	0.32**	0.32**	0.11**	
La Jolla and Point Loma	0.56**	0.44*	0.27**	0.27*	0.26**	0.15**	0.21**	0.32**	0.29**	0.09	0.15*

Table B.3. PERMANOVA and BestaDispter (test for homogeneity of multivariate dispersions) results for benthic macroinvertebrate (swath data) community structure among Geographic Areas (Region). If there are significant differences in the multivariate dispersions among sites within Geographic Areas then PERMANOVA results should be interpreted with additional caution. However, in this case only one pairwise BetaDisper comparison was significant. Values below are the PERMANOVA R^2 statistics from pairwise tests of significant differences in community structure. Statistically significant values are indicated by * [Pr(>F) < 0.05] and ** [Pr(>F) < 0.005]. Tests were run using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each site.

PERMANOVA (adonis in R)						
	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Region	11	11.054	1.005	12.041	0.623	0.001
Residuals	80	6.676	0.083		0.377	
Total	91	17.730			1.000	
BetaDisper Test						
	Df	SumsOfSqs	MeanSqs	F	N.Perm	Pr(>F)
Groups	11	0.209	0.019	2.083	999	0.033
Residuals	80	0.730	0.009			
Tukey HSD (alpha = 0.05) Significant Pariwise BetaDisper Comparisons						
Regions						
No significant pairwise dispersion differences						

Region	San Miguel Island	Santa Rosa Island	Santa Cruz Island	Anacapa Island	Santa Barbara Island	Santa Catalina Island	San Clemente Island	Santa Barbara County	Malibu	Palos Verdes	Orange and North County
Santa Rosa Island	0.29										
Santa Cruz Island	0.48**	0.43**									
Anacapa Island	0.6*	0.61*	0.18*								
Santa Barbara Island	0.55*	0.51*	0.29**	0.2							
Santa Catalina Island	0.56**	0.54**	0.68**	0.49**	0.49**						
San Clemente Island	0.49**	0.46**	0.6**	0.42**	0.37**	0.18**					
Santa Barbara County	0.29	0.23	0.34**	0.35*	0.34*	0.53**	0.47**				
Malibu	0.49*	0.44*	0.28**	0.38*	0.34*	0.56**	0.48**	0.23*			
Palos Verdes	0.34**	0.26**	0.41**	0.31**	0.23**	0.52**	0.37**	0.24**	0.23*		
Orange and North County	0.52**	0.51*	0.65**	0.54**	0.5**	0.34**	0.28**	0.43**	0.5**	0.34**	
La Jolla and Point Loma	0.54*	0.56*	0.66**	0.59*	0.52**	0.36**	0.29**	0.45**	0.6**	0.32**	0.24**

Table B.4.1 PERMANOVA and BestaDispter (test for homogeneity of multivariate dispersions) results for kelp (swath data) community structure among Geographic Areas (Region). If there are significant differences in the multivariate dispersions among sites within Geographic Areas then PERMANOVA results should be interpreted with additional caution. However, in this case only one pairwise BetaDisper comparison was significant. Values below are the PERMANOVA R^2 statistics from pairwise tests of significant differences in community structure. Statistically significant values are indicated by * [Pr(>F) < 0.05] and ** [Pr(>F) < 0.005]. Tests were run using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each site.

PERMANOVA (adonis in R)						
	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Region	11	4.565	0.415	3.662	0.335	0.001
Residuals	80	9.067	0.113		0.665	
Total	91	13.632			1.000	
BetaDisper Test						
	Df	SumsOfSqs	MeanSqs	F	N.Perm	Pr(>F)
Groups	11	0.446	0.041	2.086	999	0.029
Residuals	80	1.556	0.019			
Tukey HSD (alpha = 0.05) Significant Pariwise BetaDisper Comparisons						
Regions						
No significant pairwise dispersion differences						

Region	San Miguel Island	Santa Rosa Island	Santa Cruz Island	Anacapa Island	Santa Barbara Island	Santa Catalina Island	San Clemente Island	Santa Barbara County	Malibu	Palos Verdes	Orange and North County
Santa Rosa Island	0.14										
Santa Cruz Island	0.04	0.12									
Anacapa Island	0.16	0.35	0.04								
Santa Barbara Island	0.08	0.31*	0.02	0.08							
Santa Catalina Island	0.13*	0.28**	0.11*	0.08	0.09						
San Clemente Island	0.2*	0.35**	0.1*	0.1	0.18*	0.15**					
Santa Barbara County	0.15	0.18	0.23*	0.39*	0.37*	0.43**	0.49**				
Malibu	0.07	0.25	0.15*	0.32*	0.28*	0.3**	0.39**	0.14			
Palos Verdes	0.06	0.13*	0.14*	0.21*	0.19*	0.27**	0.29**	0.16*	0.07		
Orange and North County	0.07	0.33*	0.1	0.17	0.08	0.16**	0.31**	0.4**	0.22*	0.18*	
La Jolla and Point Loma	0.2	0.35*	0.16*	0.28*	0.32*	0.28**	0.27**	0.32*	0.25*	0.2*	0.38**

Table B.4.2 PERMANOVA and BestaDispter (test for homogeneity of multivariate dispersions) results for kelp ***with Macrocystis pyrifera stipe density*** (swath data) community structure among Geographic Areas (Region). If there are significant differences in the multivariate dispersions among sites within Geographic Areas then PERMANOVA results should be interpreted with additional caution. However, in this case only one pairwise BetaDisper comparison was significant. Values below are the PERMANOVA R^2 statistics from pairwise tests of significant differences in community structure. Statistically significant values are indicated by * [Pr(>F) < 0.05] and ** [Pr(>F) < 0.005]. Tests were run using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each site.

PERMANOVA (adonis in R)						
	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Region	11	3.219	0.293	3.360	0.316	0.001
Residuals	80	6.968	0.087		0.684	
Total	91	10.188			1.000	
BetaDisper Test						
	Df	SumsOfSqs	MeanSqs	F	N.Perm	Pr(>F)
Groups	11	0.436	0.040	1.878	999	0.061
Residuals	80	1.689	0.021			
Tukey HSD (alpha = 0.05) Significant Pariwise BetaDisper Comparisons						
Regions						
No significant pairwise dispersion differences						

Region	San Miguel Island	Santa Rosa Island	Santa Cruz Island	Anacapa Island	Santa Barbara Island	Santa Catalina Island	San Clemente Island	Santa Barbara County	Malibu	Palos Verdes	Orange and North County
Santa Rosa Island	0.15										
Santa Cruz Island	0.05	0.1									
Anacapa Island	0.16	0.31	0.03								
Santa Barbara Island	0.1	0.26	0.02	0.06							
Santa Catalina Island	0.12	0.27**	0.11**	0.11	0.13*						
San Clemente Island	0.2*	0.33**	0.08	0.09	0.14*	0.16**					
Santa Barbara County	0.12	0.15	0.19*	0.3*	0.28*	0.38**	0.42**				
Malibu	0.04	0.24	0.13	0.28	0.25*	0.23**	0.36**	0.13			
Palos Verdes	0.05	0.13*	0.15*	0.23*	0.21*	0.24**	0.31**	0.17*	0.06		
Orange and North County	0.08	0.41*	0.14*	0.24*	0.19*	0.16*	0.37**	0.38**	0.2*	0.16*	
La Jolla and Point Loma	0.21	0.36	0.13	0.22	0.23*	0.27**	0.22**	0.27*	0.28*	0.26**	0.49**

Table B.5. PERMANOVA and BestaDispter (test for homogeneity of multivariate dispersions) results for benthic cover (UPC data) community structure among Geographic Areas (Region). If there are significant differences in the multivariate dispersions among sites within Geographic Areas then PERMANOVA results should be interpreted with additional caution. However, in this case only one pairwise BetaDisper comparison was significant. Values below are the PERMANOVA R^2 statistics from pairwise tests of significant differences in community structure. Statistically significant values are indicated by * [Pr(>F) < 0.05] and ** [Pr(>F) < 0.005]. Tests were run using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each site.

PERMANOVA (adonis in R)						
	Df	SumsOfSqs	MeanSqs	F.Model	R2	Pr(>F)
Region	11	2.947	0.268	6.155	0.458	0.001
Residuals	80	3.482	0.044		0.542	
Total	91	6.429			1.000	
BetaDisper Test						
	Df	SumsOfSqs	MeanSqs	F	N.Perm	Pr(>F)
Groups	11	0.060	0.005	2.215	999	0.025
Residuals	80	0.196	0.002			
Tukey HSD (alpha = 0.05) Significant Pariwise BetaDisper Comparisons						
Regions	p_adj					
Santa Catalina Island-Santa Rosa Island	0.049					

Region	San Miguel Island	Santa Rosa Island	Santa Cruz Island	Anacapa Island	Santa Barbara Island	Santa Catalina Island	San Clemente Island	Santa Barbara County	Malibu	Palos Verdes	Orange and North County
Santa Rosa Island	0.29										
Santa Cruz Island	0.09	0.32**									
Anacapa Island	0.12	0.4	0.09								
Santa Barbara Island	0.19	0.34*	0.21**	0.21							
Santa Catalina Island	0.18**	0.24**	0.28**	0.17**	0.12*						
San Clemente Island	0.32**	0.3**	0.48**	0.35**	0.32**	0.19**					
Santa Barbara County	0.25*	0.45*	0.25**	0.27*	0.37*	0.37**	0.49**				
Malibu	0.24	0.3*	0.26**	0.31*	0.3*	0.27**	0.35**	0.38**			
Palos Verdes	0.21**	0.28*	0.35**	0.27**	0.16**	0.16**	0.24**	0.42**	0.28**		
Orange and North County	0.33**	0.3**	0.44**	0.35**	0.3**	0.28**	0.28**	0.43**	0.26**	0.29**	
La Jolla and Point Loma	0.33*	0.4*	0.42**	0.39*	0.29*	0.22**	0.21**	0.47**	0.29*	0.2**	0.14*

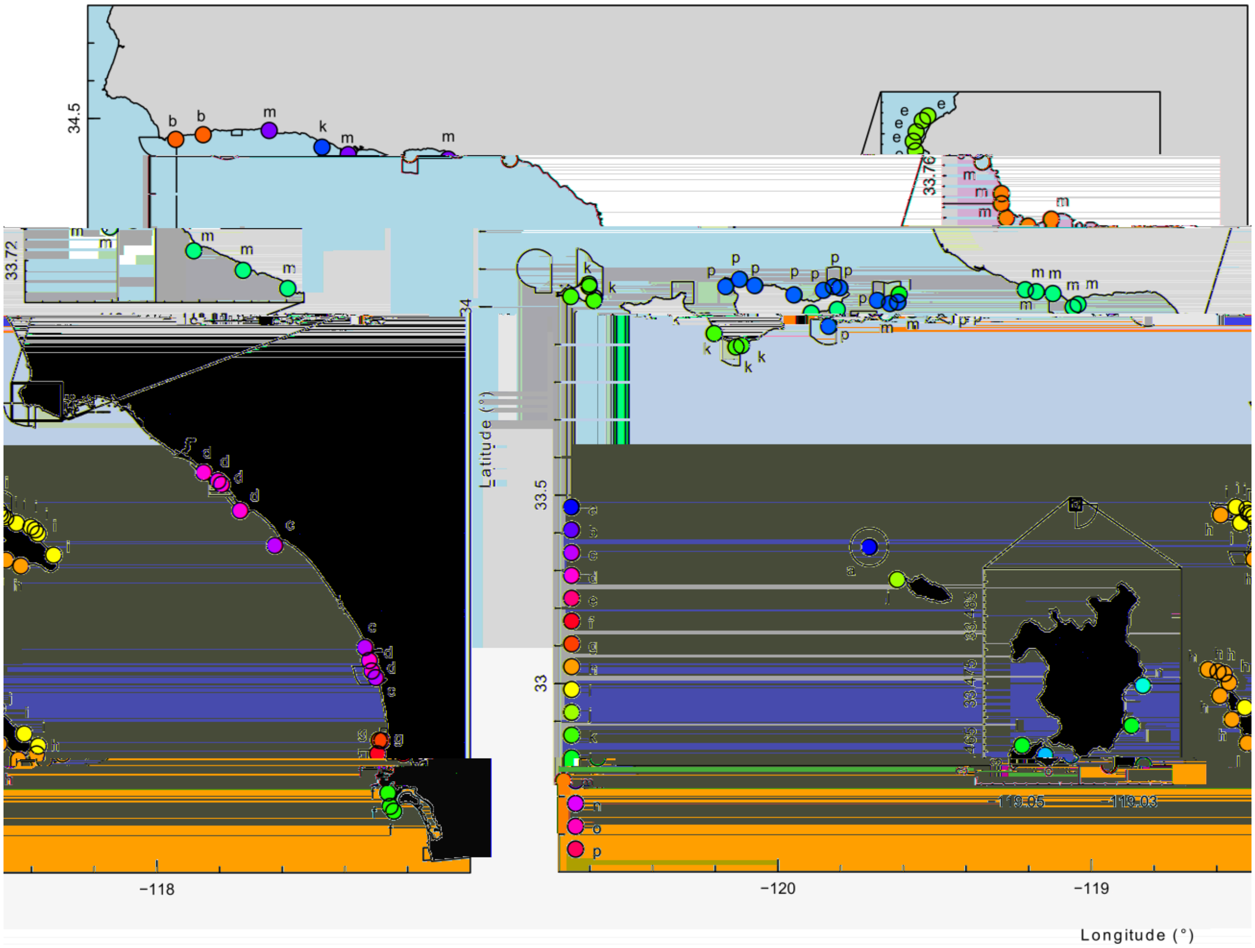


Figure B.1. Geographic distribution of 16 significantly different kelp forest community clusters determined with a cluster analysis and a SIMPROF test (alpha = 0.01) using the Bray-Curtis similarity coefficient. The data used in the analysis were square root transformed average density of fishes, invertebrates, and kelps (site means averaged across 2011 and 2012). Note for this analysis ***Macrocystis pyrifera*** **stipe density (stipes per 100 m^2)** was used instead of the density of *Macrocystis pyrifera* individuals.

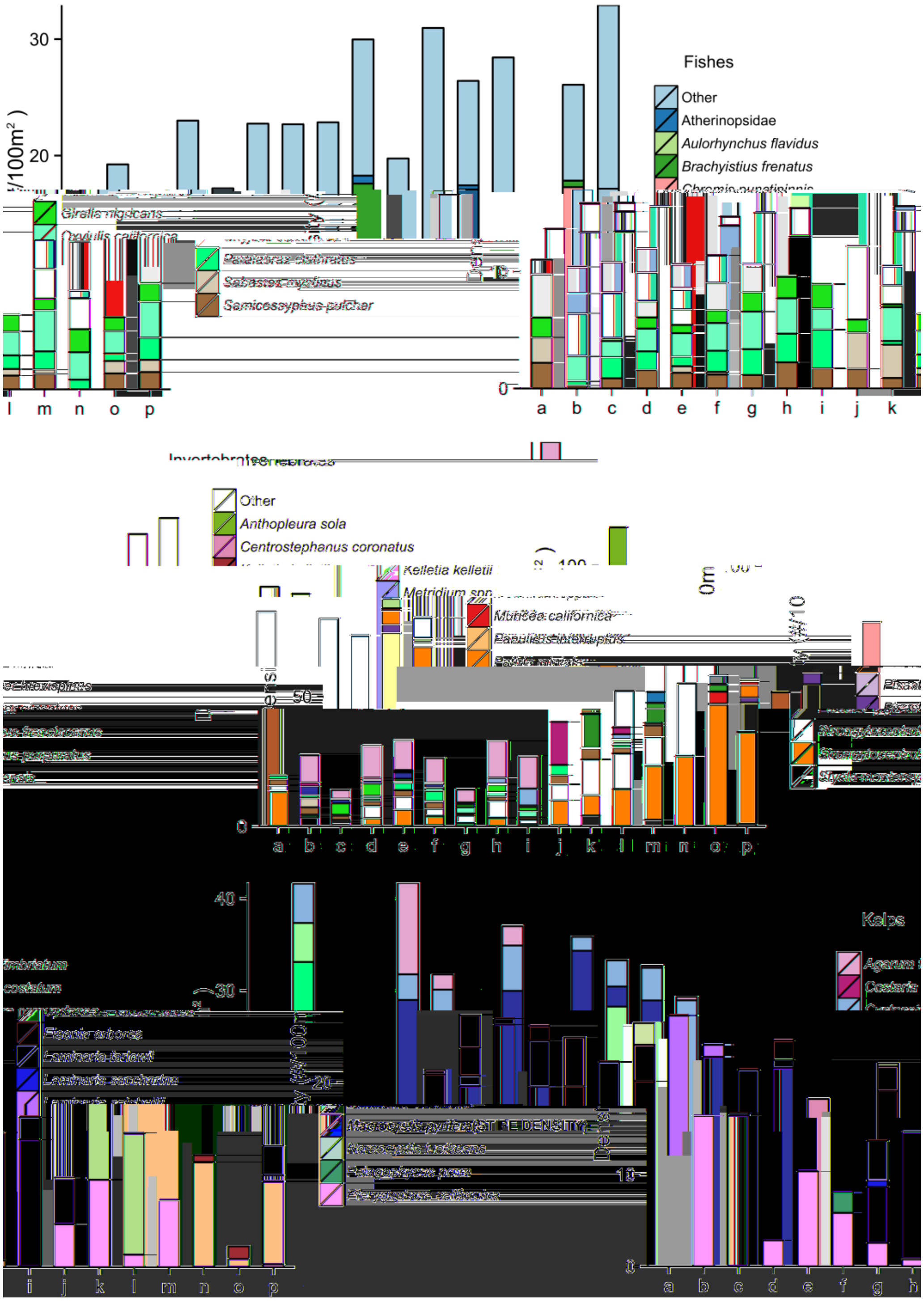


Figure B.2. Average density of fishes, invertebrates, and kelps and by kelp forest community cluster (see Figure B.1**)**. Note for this analysis ***Macrocystis pyrifera* stipe density (stipes per 100 m^2)** was used instead of the density of *Macrocystis pyrifera* individuals. For visual clarity, specific taxa listed in the fishes and invertebrate plots are those that account for at least 10% of the density within any of the communities. The remaining observed taxa are pooled into the 'Other' category. Note letters in this plot are assigned differently from those in Figure 5.

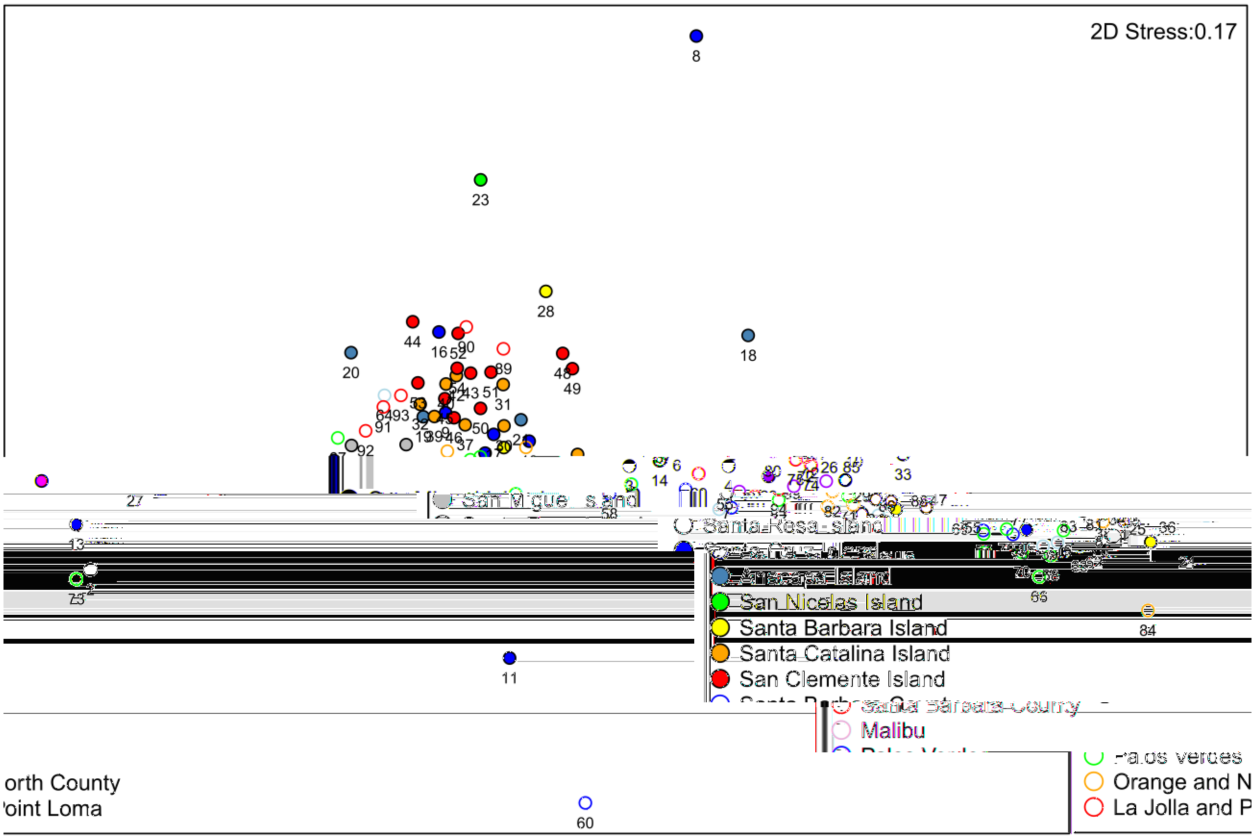


Figure B.3. Non-metric multidimensional ordination plot of kelp (swath data) communities using Bray-Curtis similarity based on the square-root transformed taxa density averaged across 2011 and 2012 for each of the 94 sites across the 14 Geographic Areas. Sites are numbered according to Figure 3. Note for this analysis ***Macrocystis pyrifera*** **stipe density (stipes per 100 m^2)** was used instead of the density of *Macrocystis pyrifera* individuals.

Appendix C

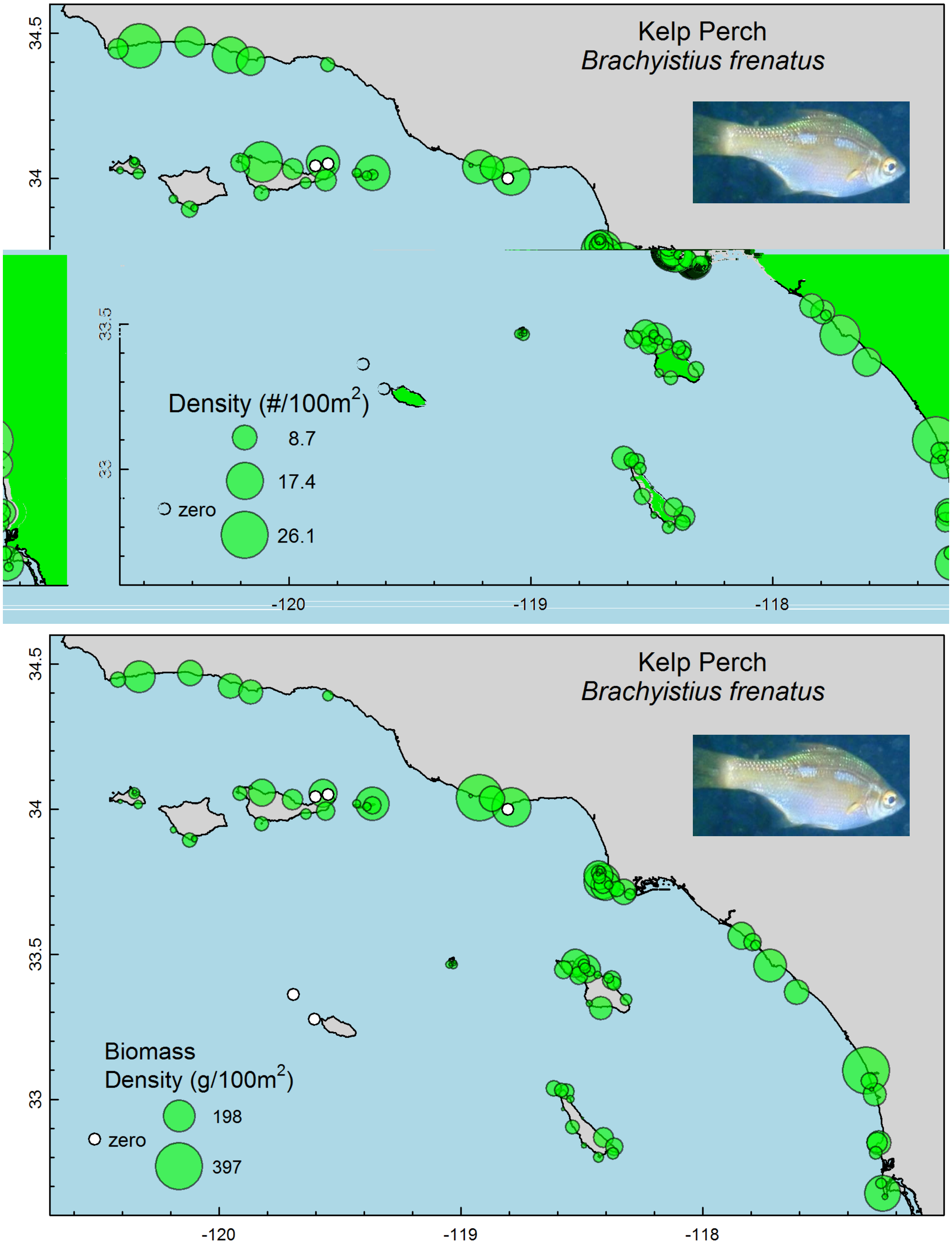


Figure C.1. Geographic distribution of *Brachyistius frenatus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

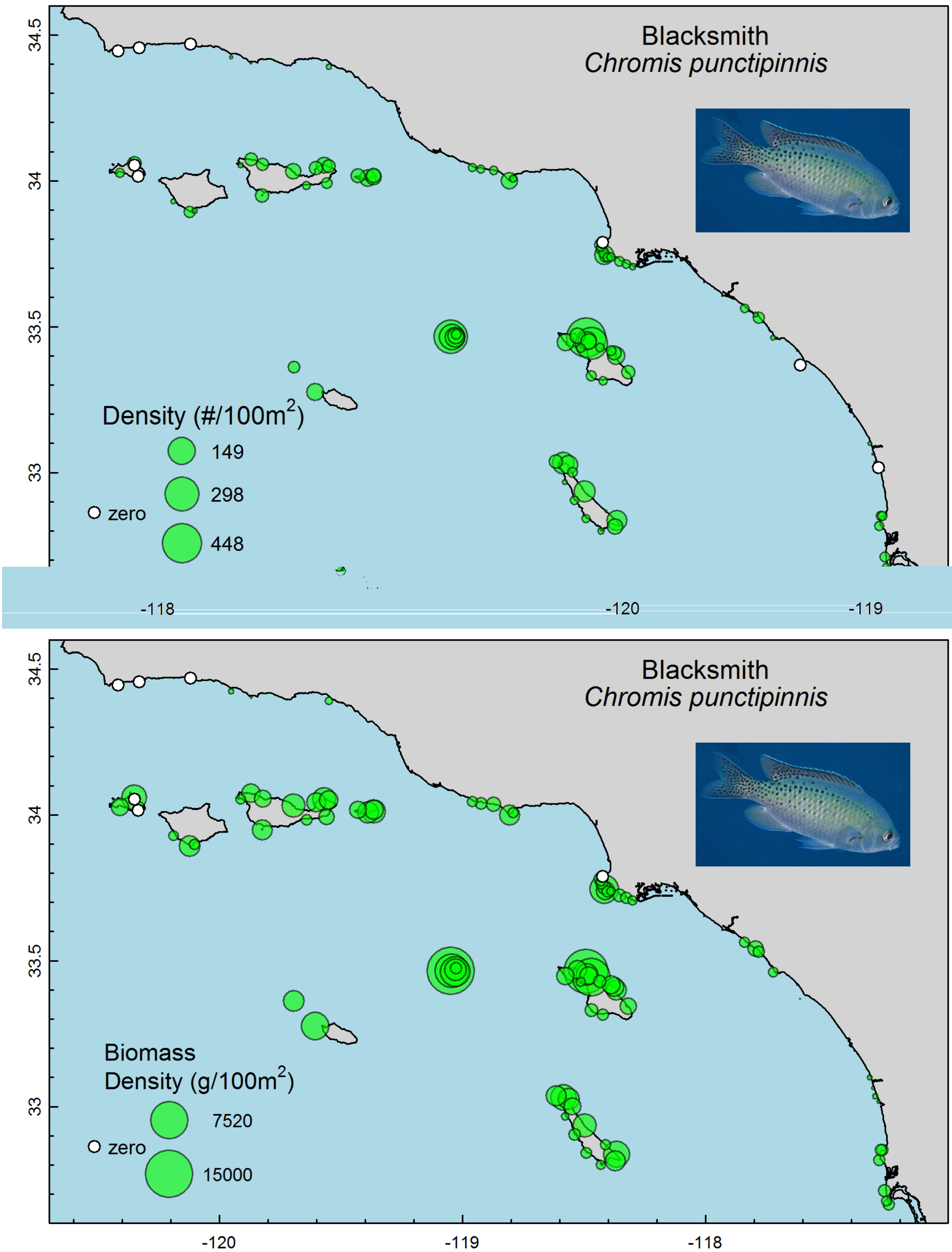


Figure C.2. Geographic distribution of *Chromis punctipinnis* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

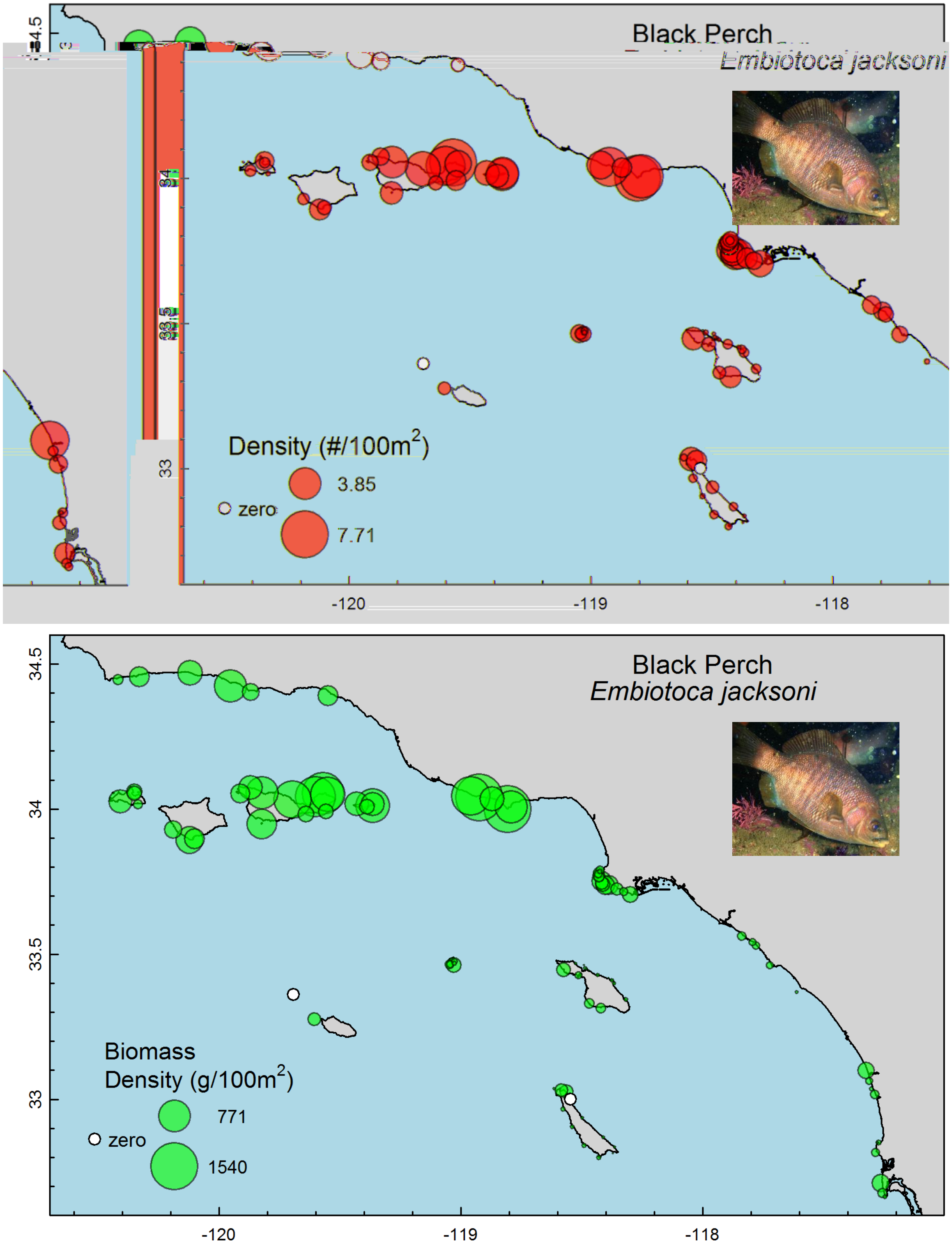


Figure C.3. Geographic distribution of *Embiotoca jacksoni* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

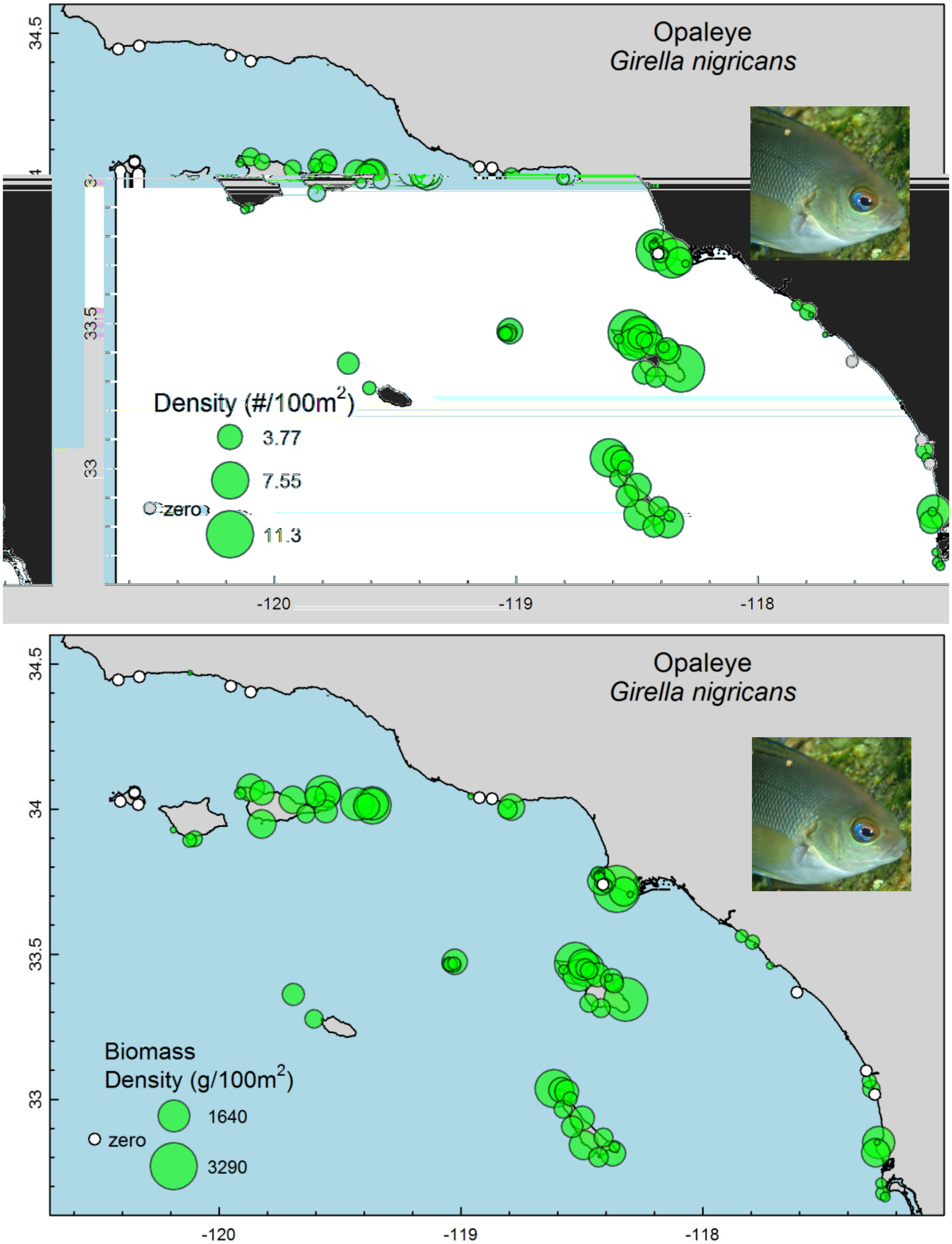


Figure C.4. Geographic distribution of *Girella nigricans* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

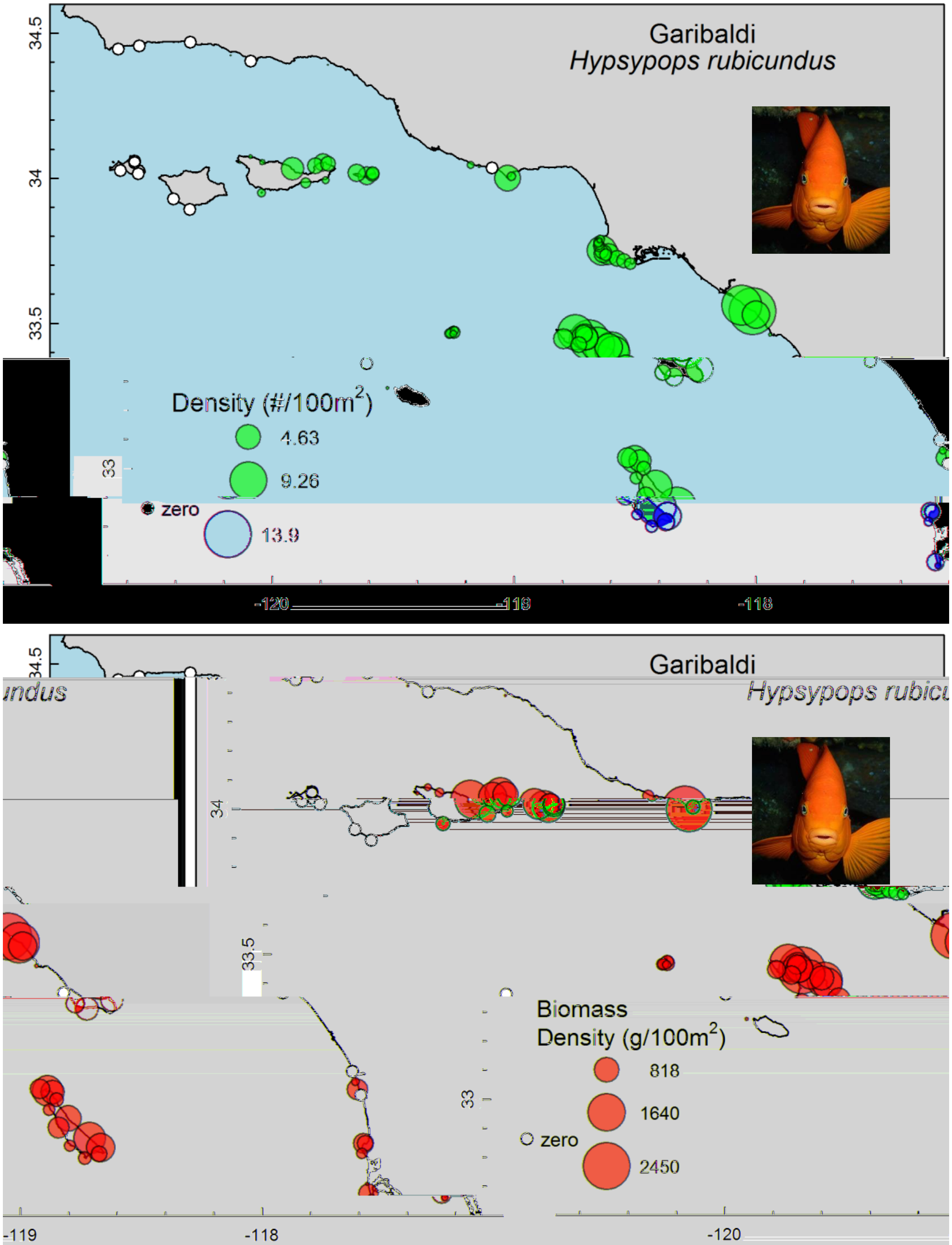


Figure C.5. Geographic distribution of *Hypsypops rubicundus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

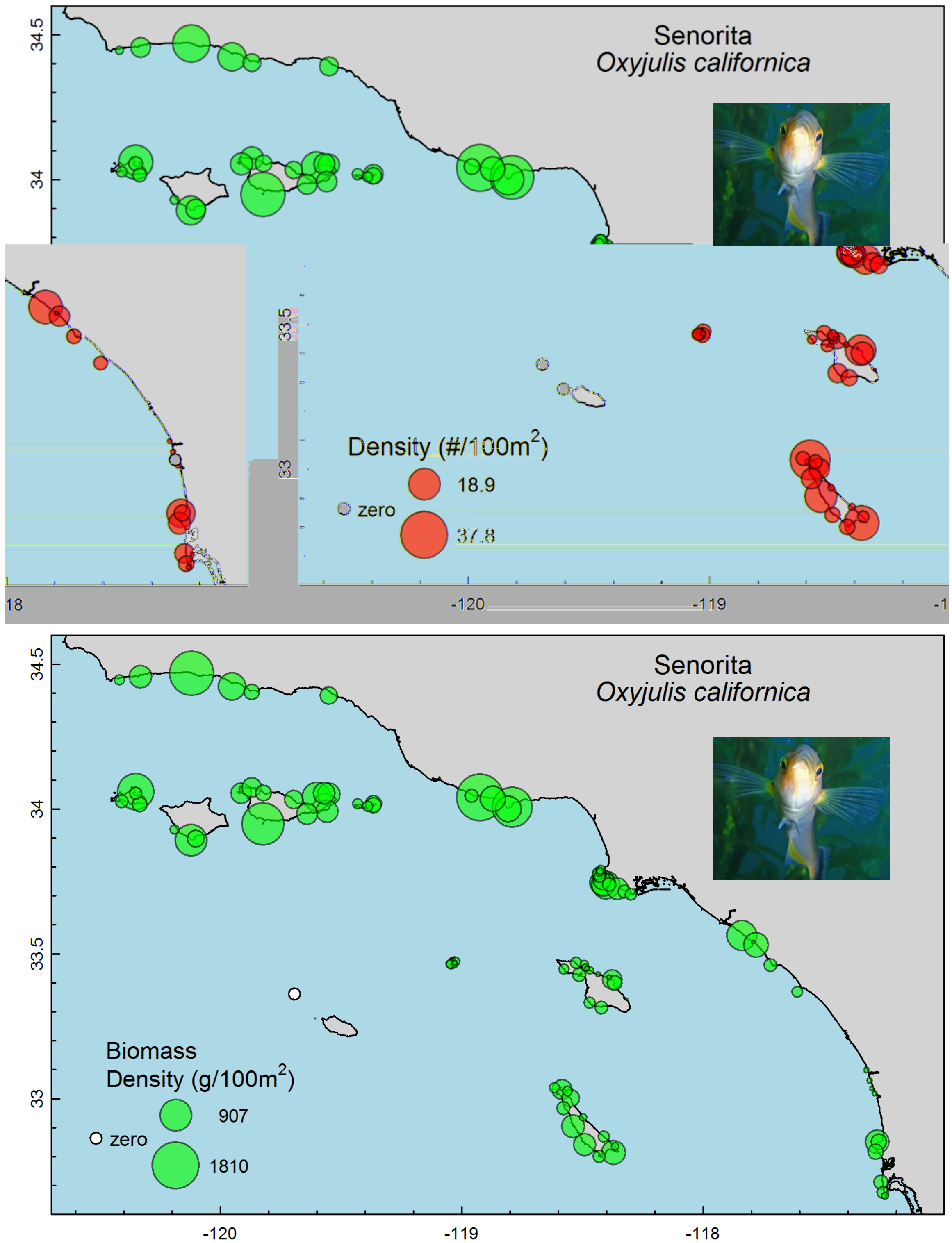


Figure C.6. Geographic distribution of *Oxyjulis californica* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

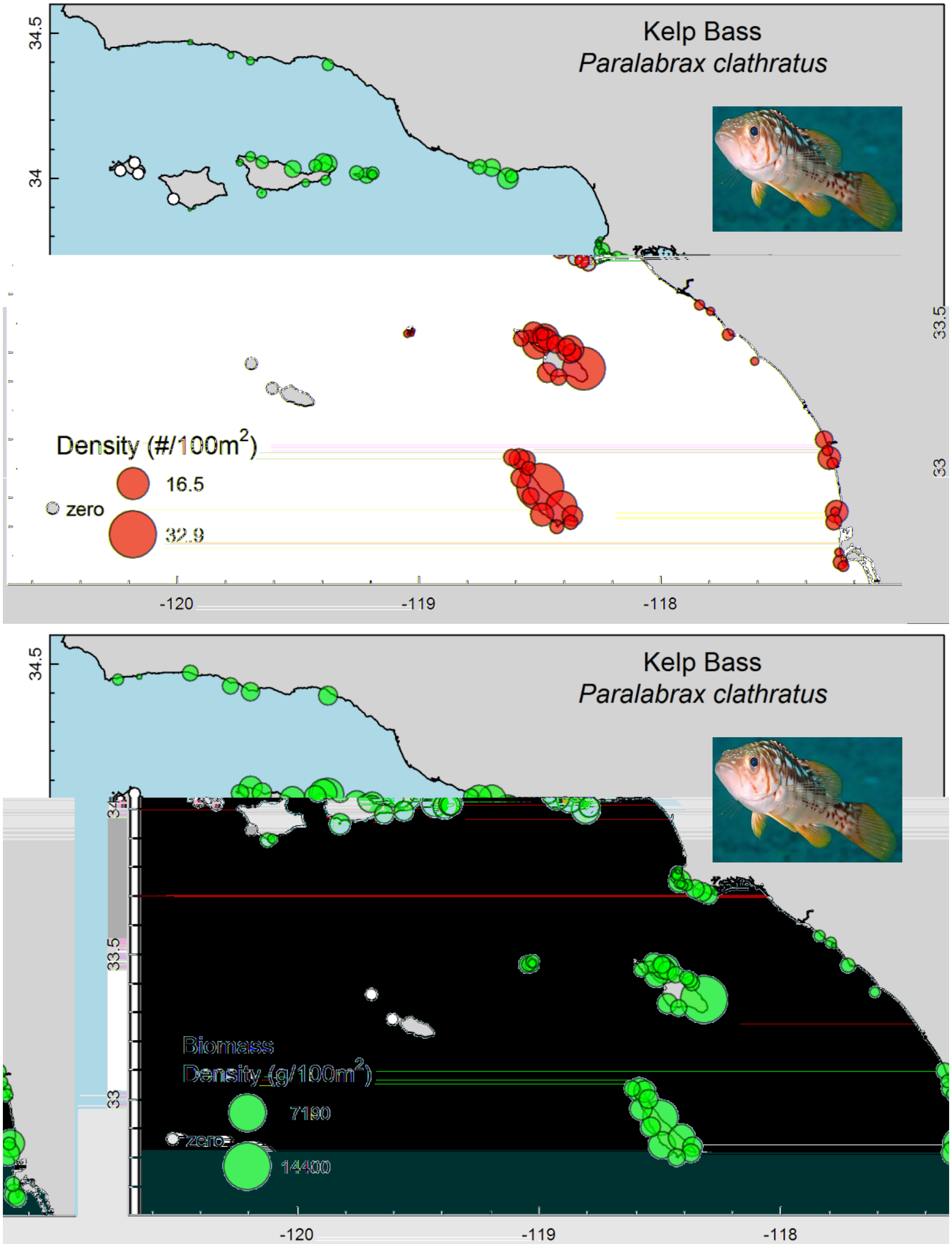


Figure C.7. Geographic distribution of *Paralabrax clathratus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

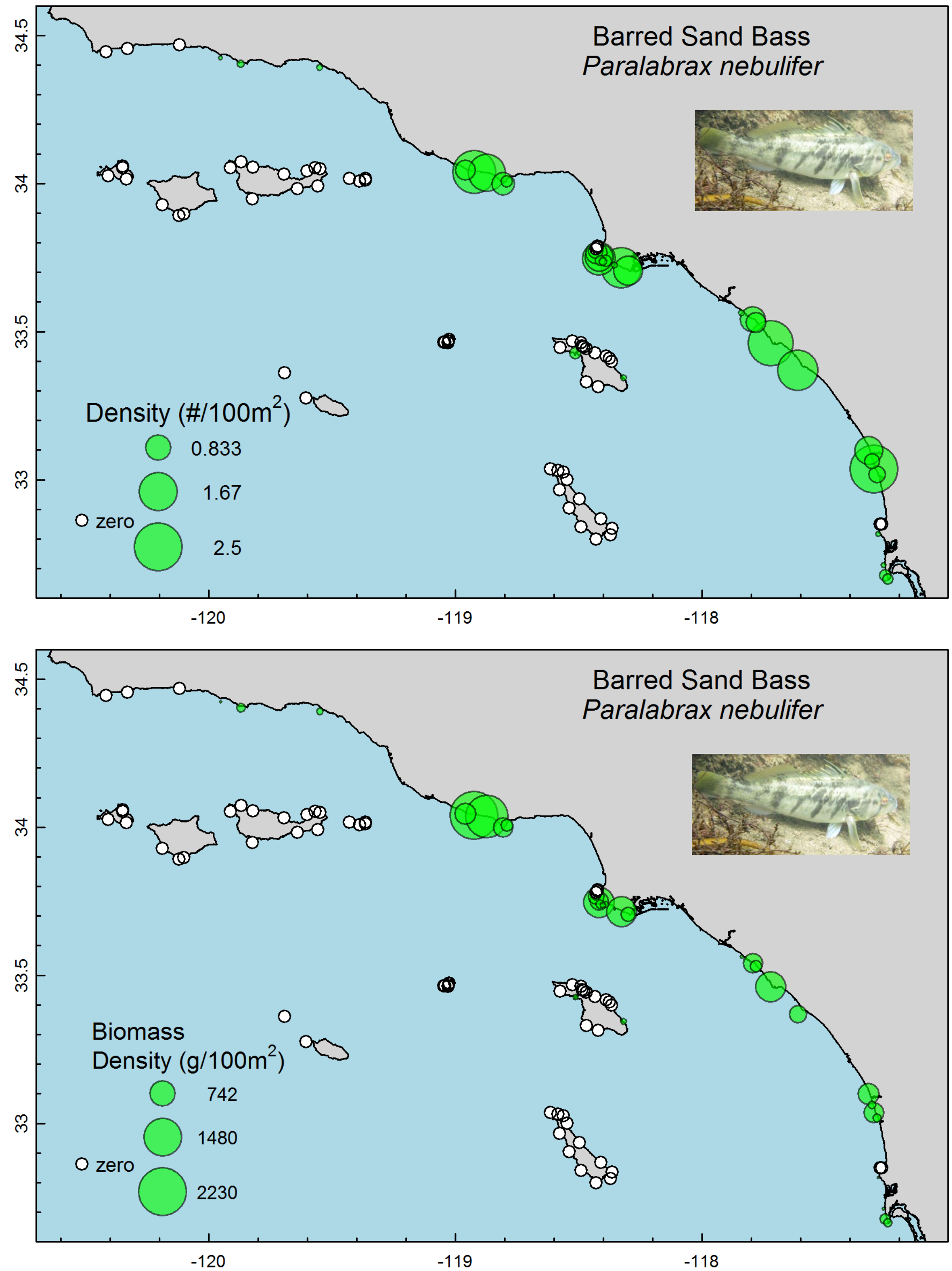
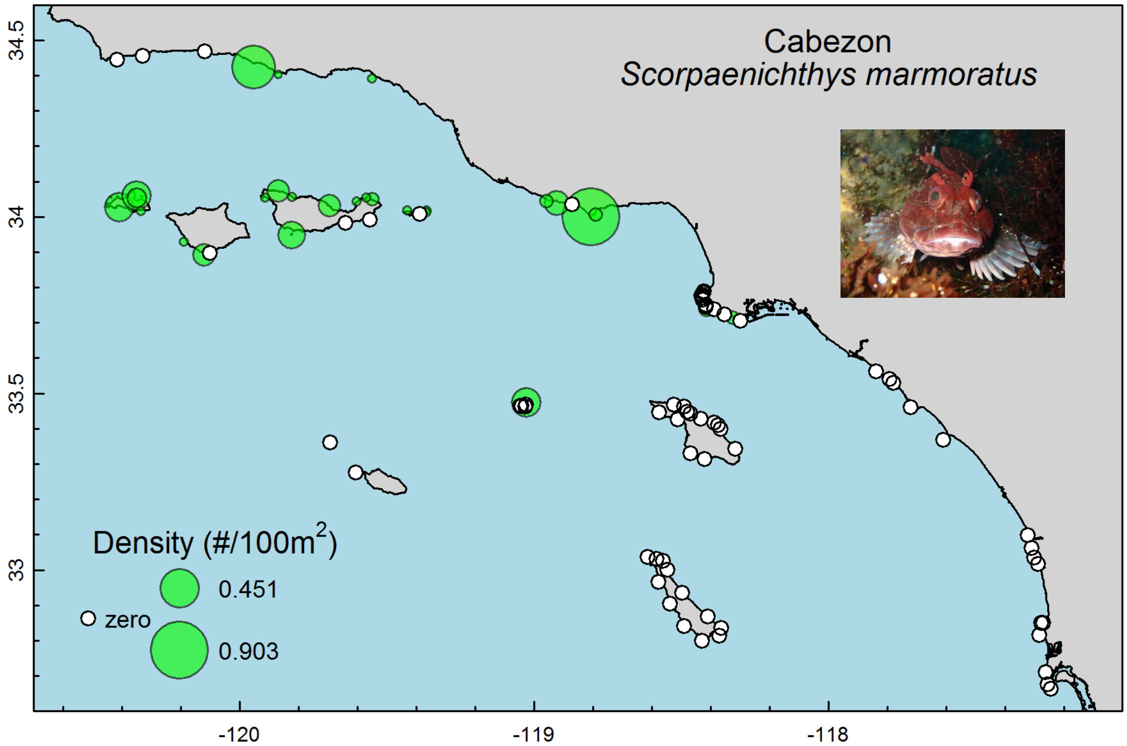


Figure C.8. Geographic distribution of *Paralabrax nebulifer* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.



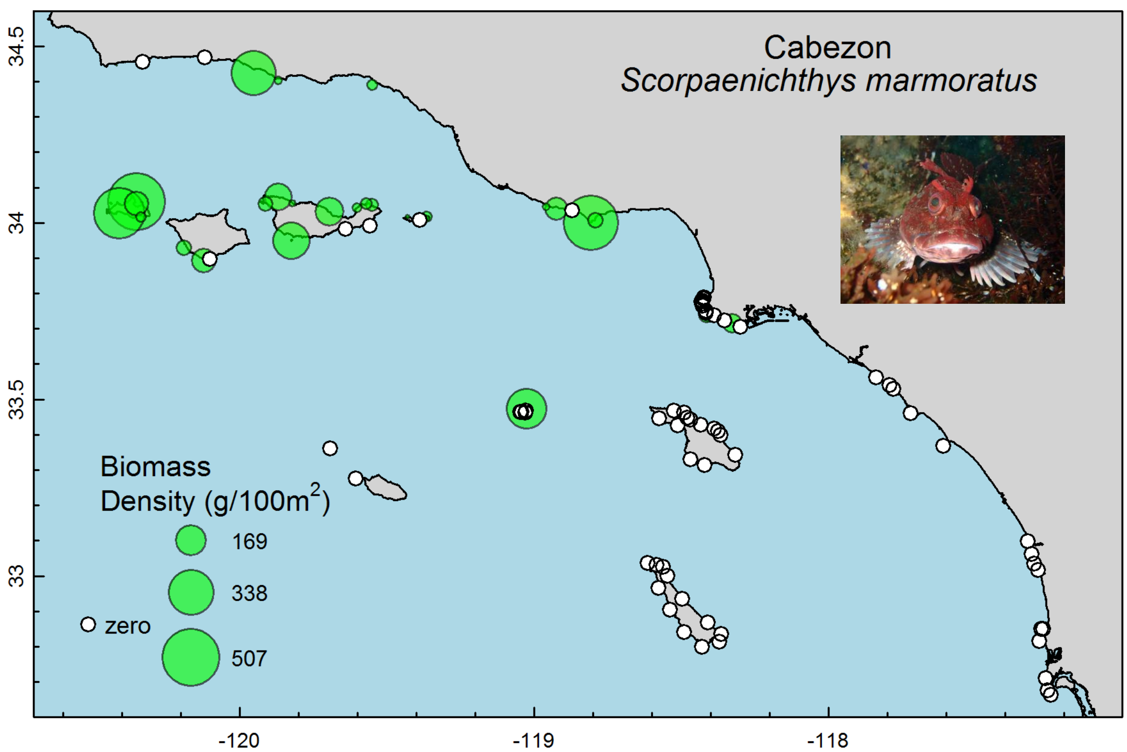
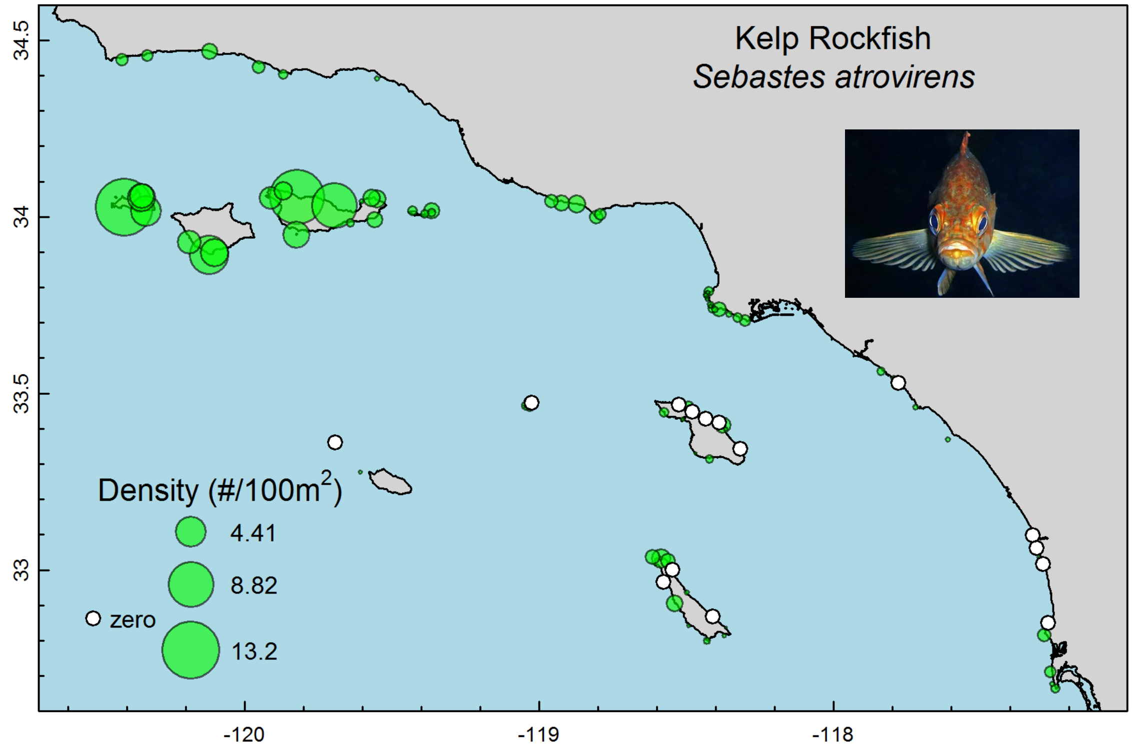


Figure C.9. Geographic distribution of *Scorpaenichthys marmoratus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.



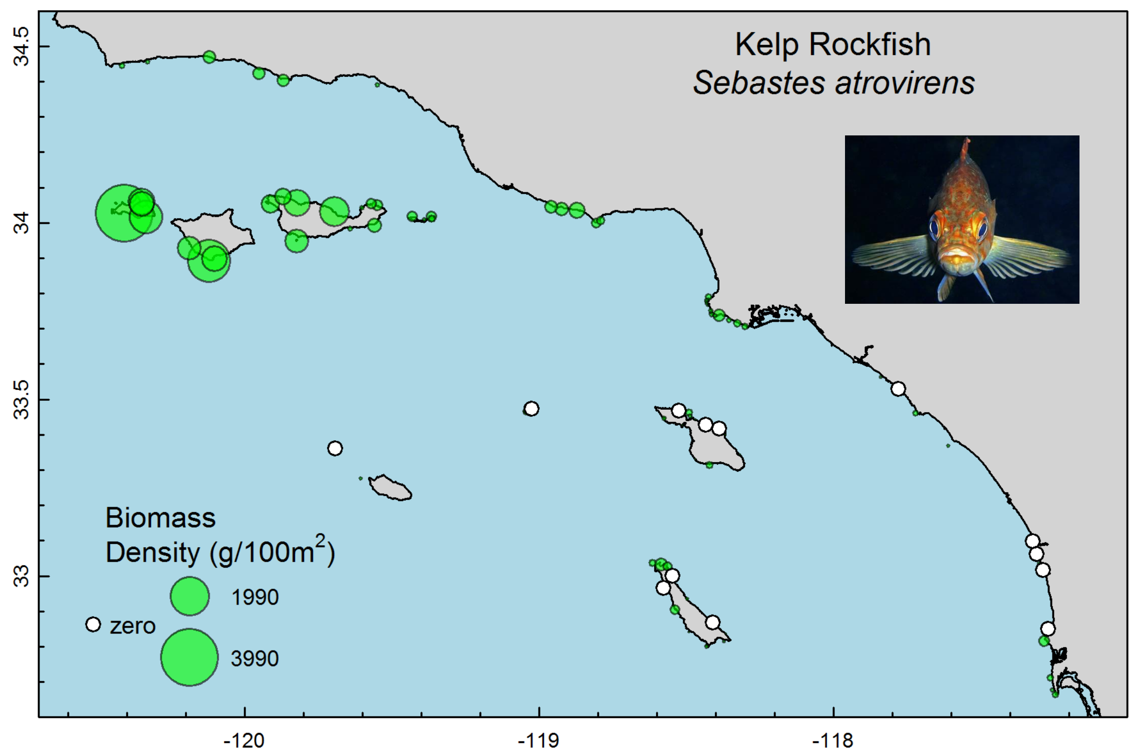


Figure C.10. Geographic distribution of *Sebastes atrovirens* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

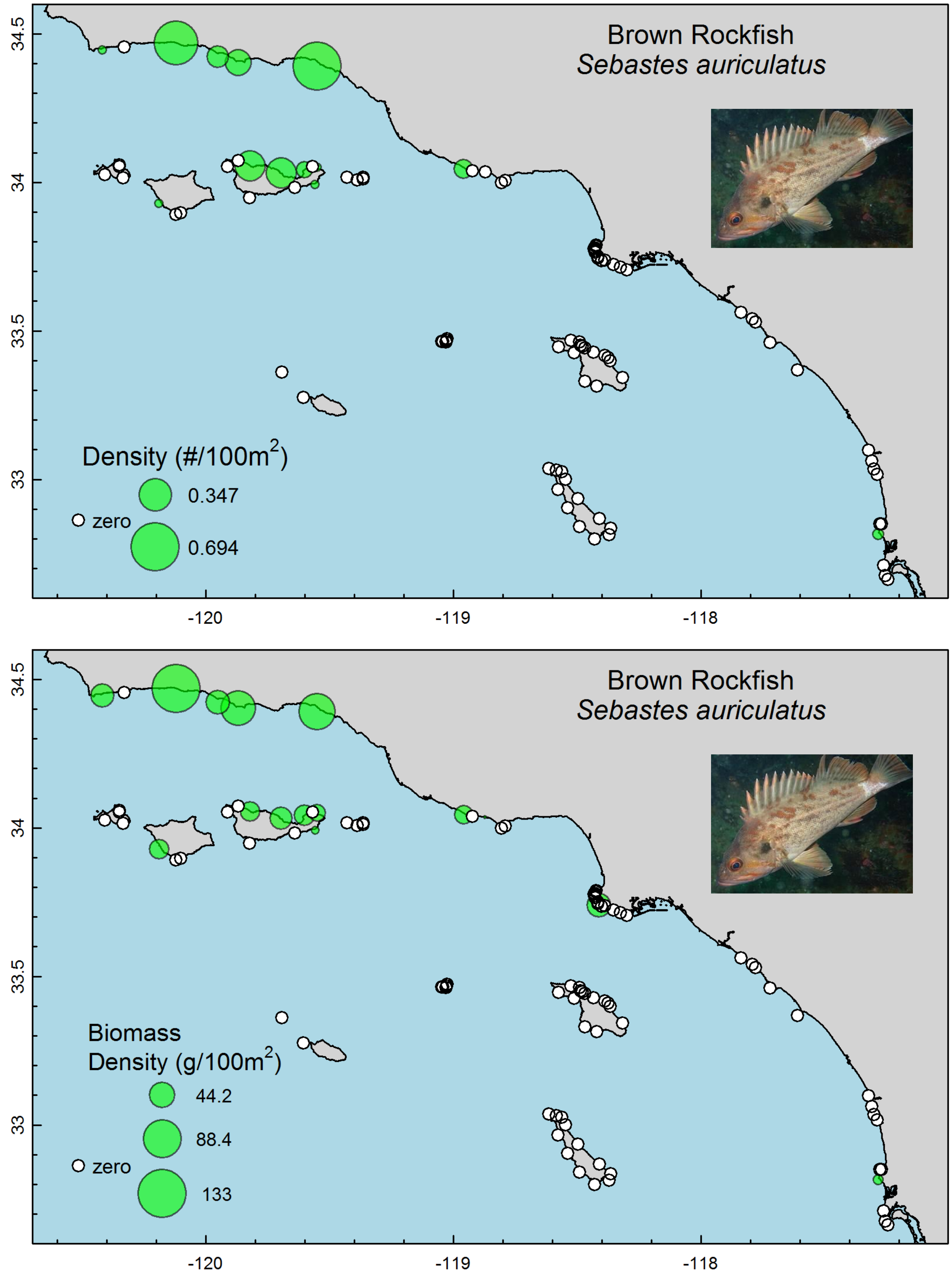


Figure C.11. Geographic distribution of *Sebastes auriculatus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

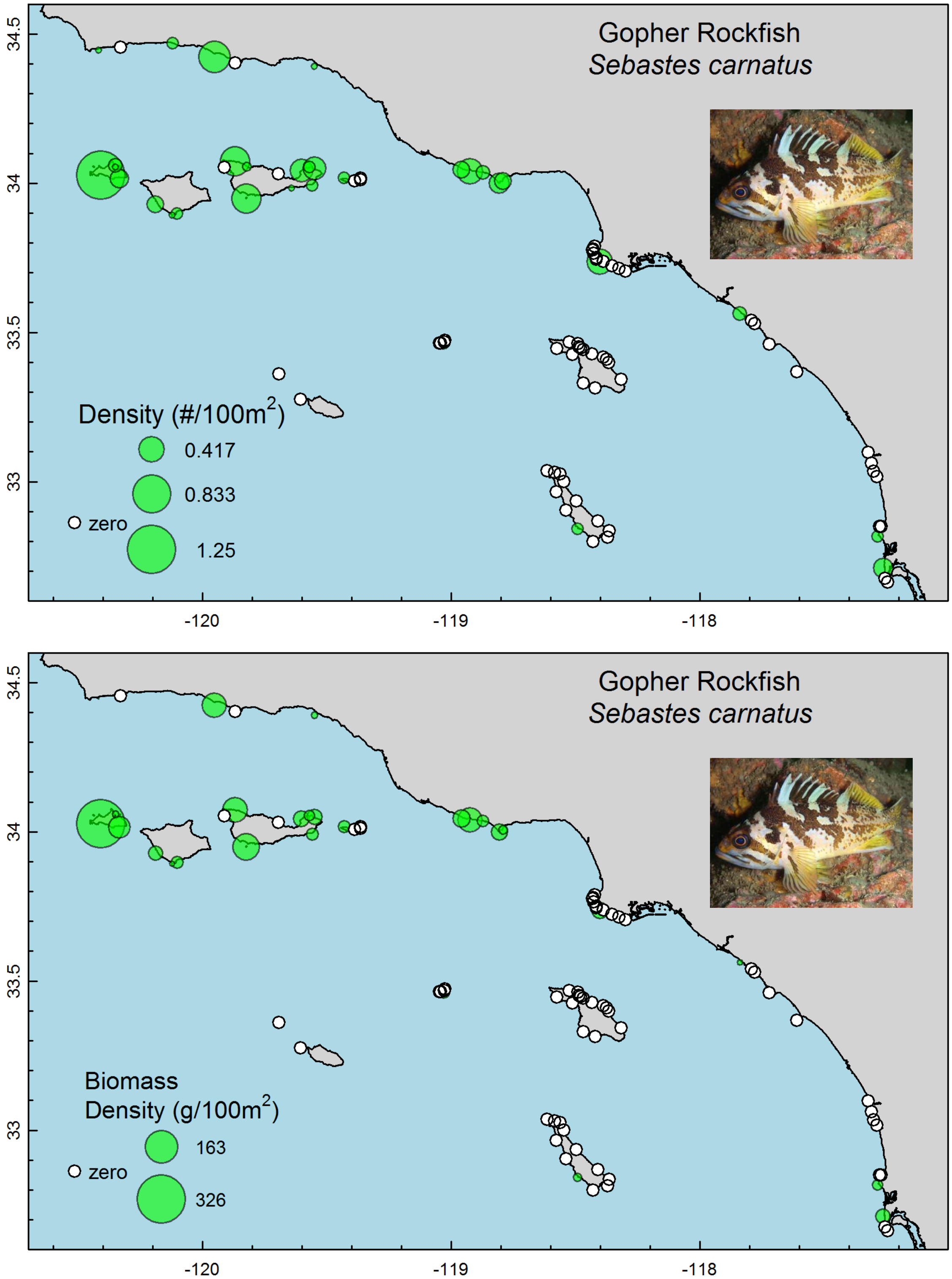


Figure C.12. Geographic distribution of *Sebastes carnatus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

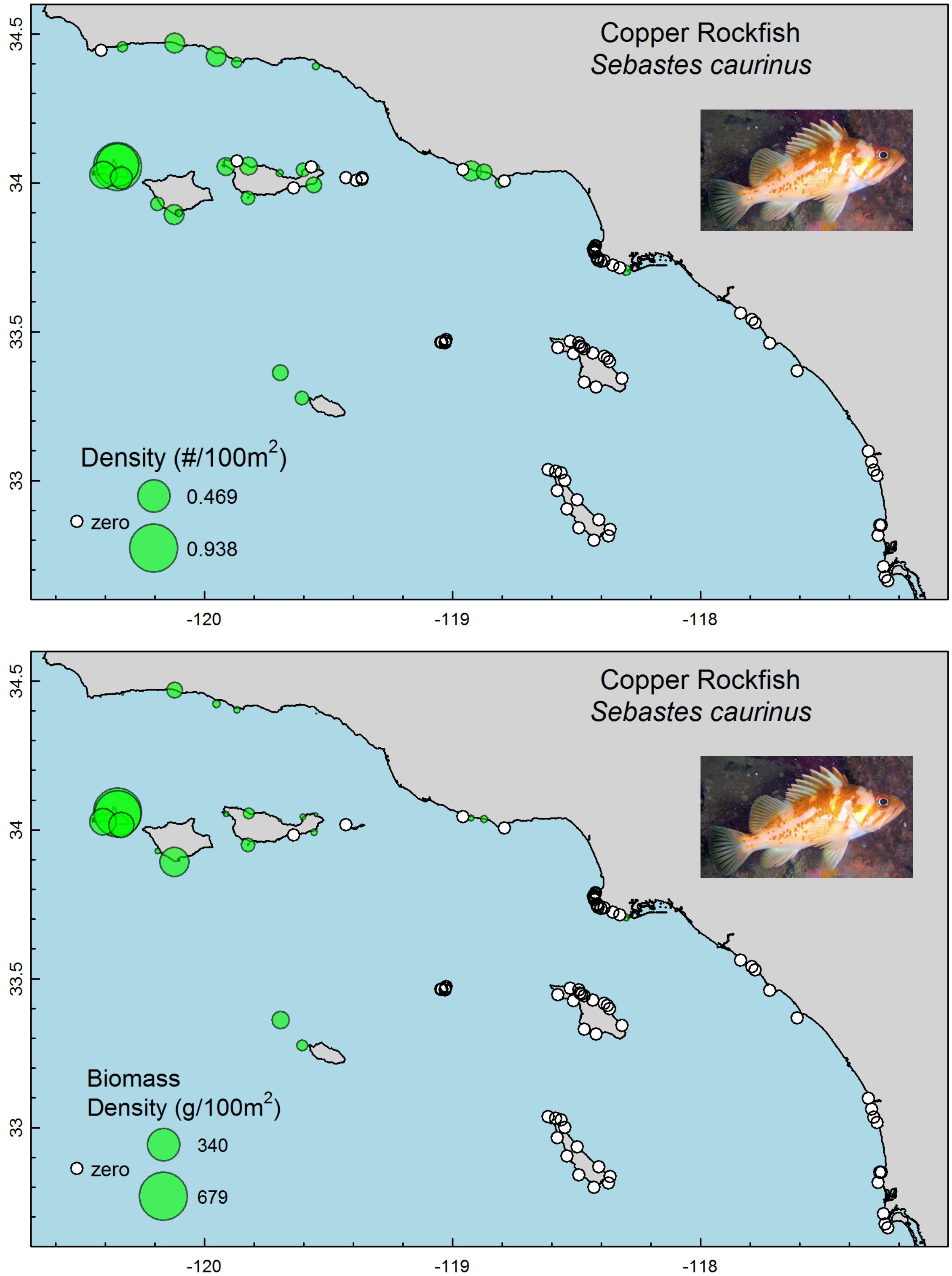


Figure C.13. Geographic distribution of *Sebastes caurinus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

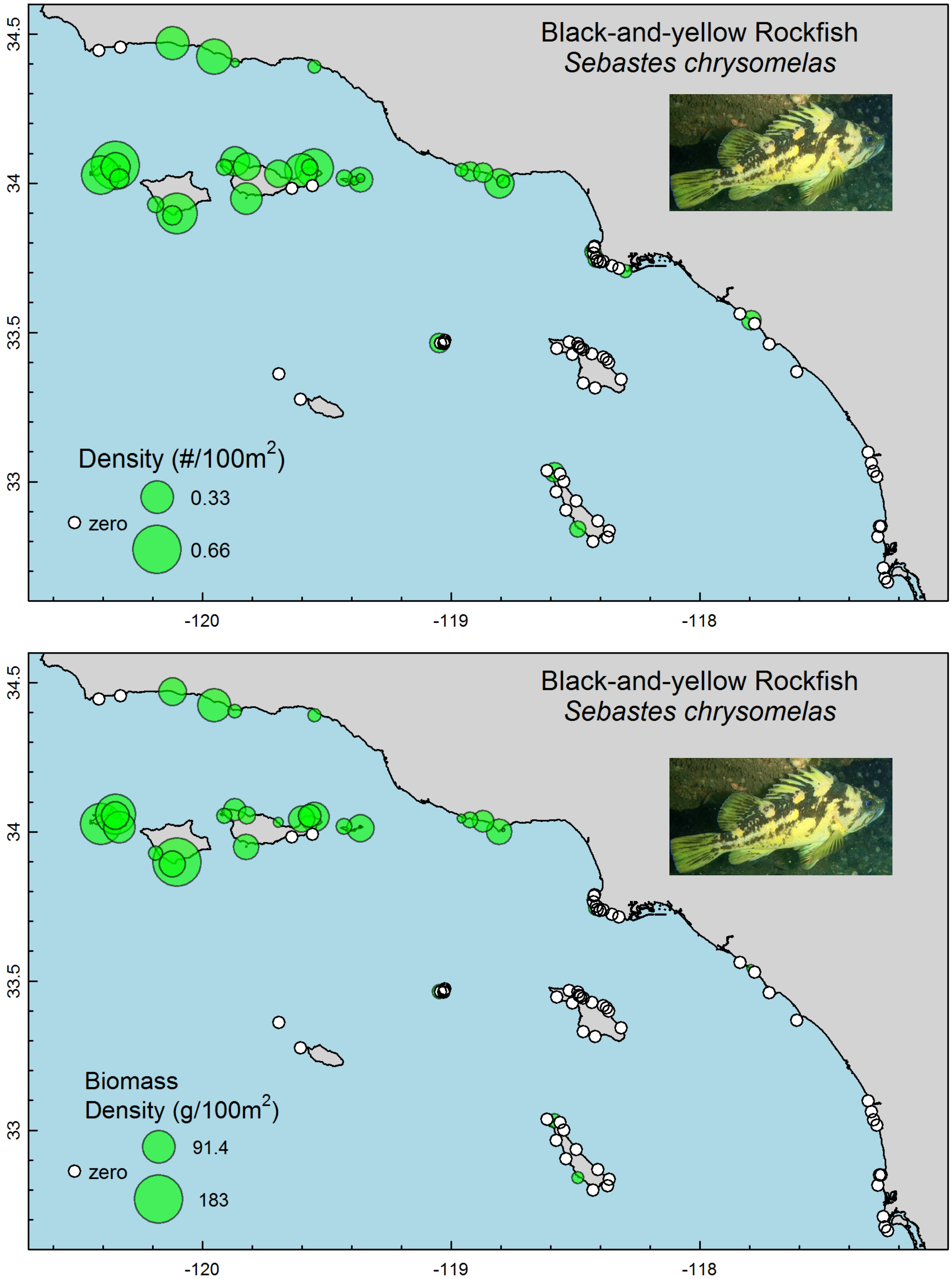


Figure C.14. Geographic distribution of *Sebastes chrysomelas* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

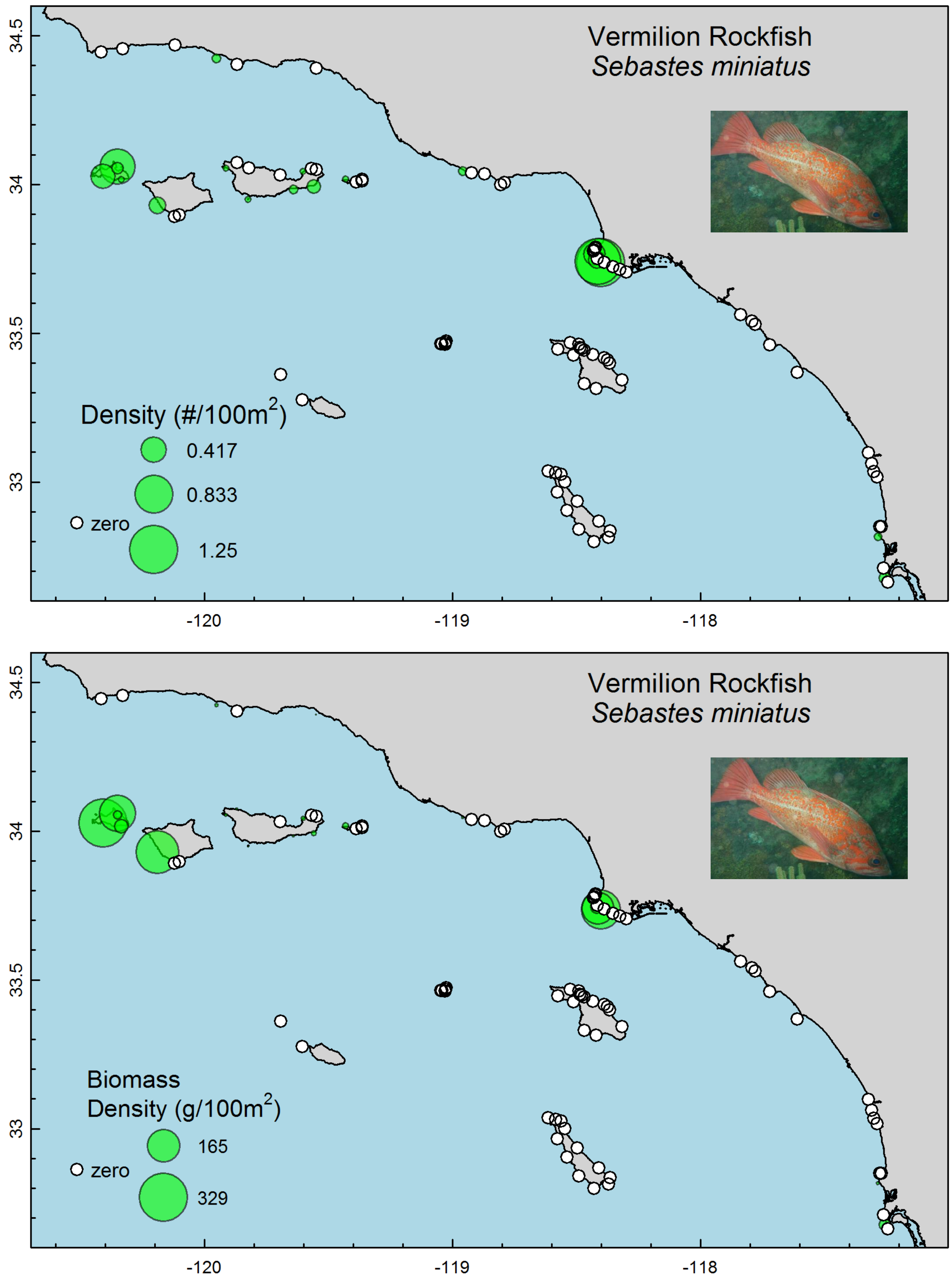


Figure C.15. Geographic distribution of *Sebastes miniatus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

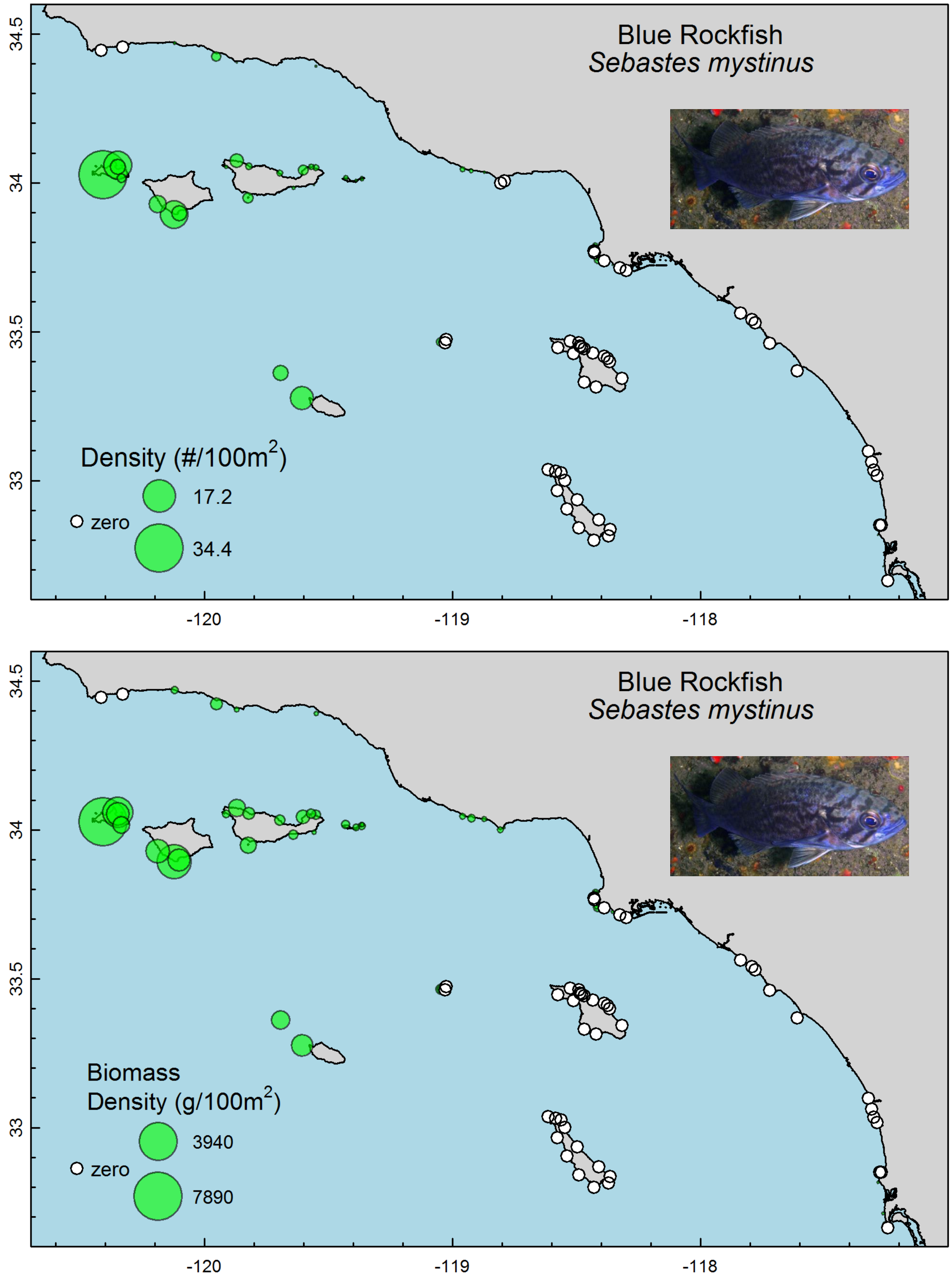


Figure C.16. Geographic distribution of *Sebastes mystinus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

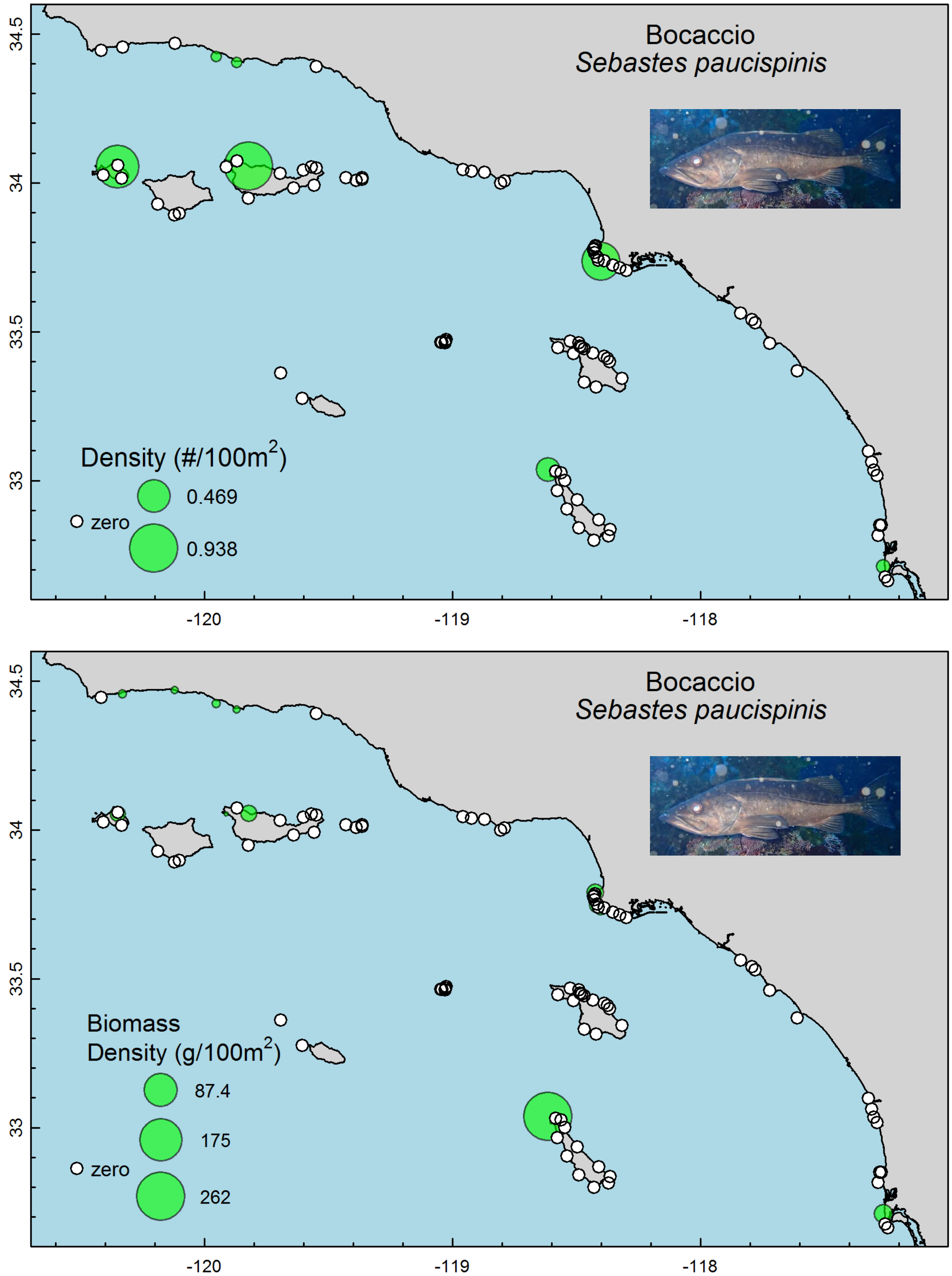
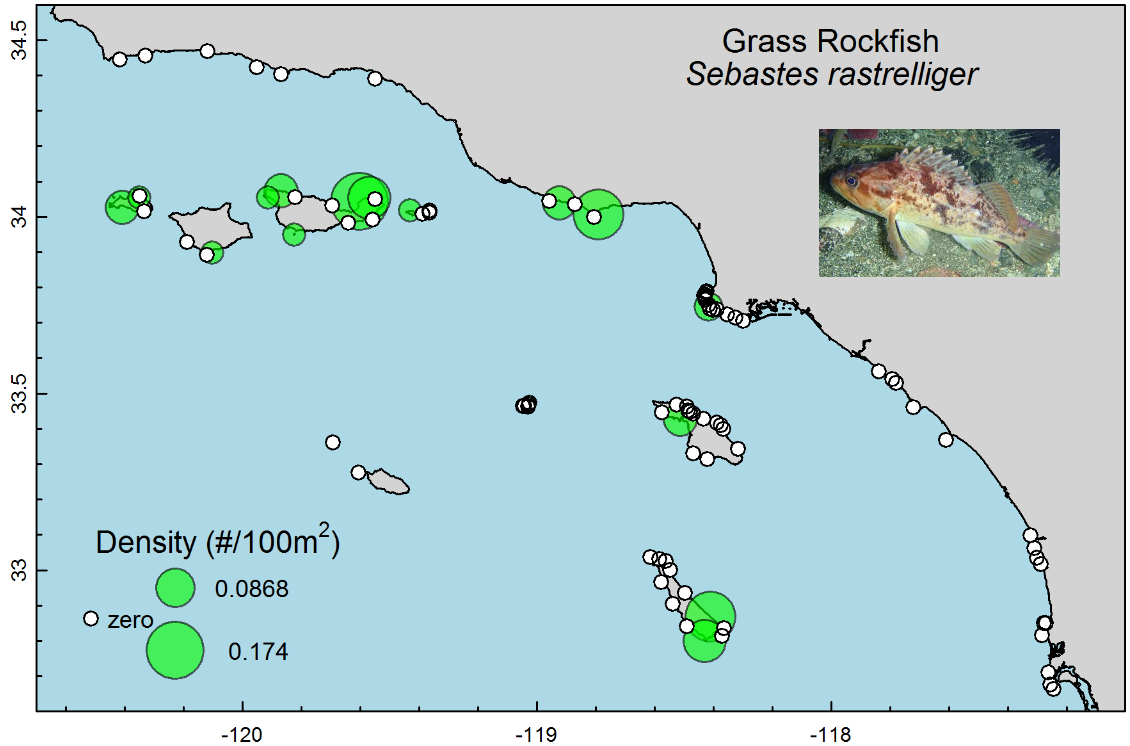


Figure C.17. Geographic distribution of *Sebastes paucispinis* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.



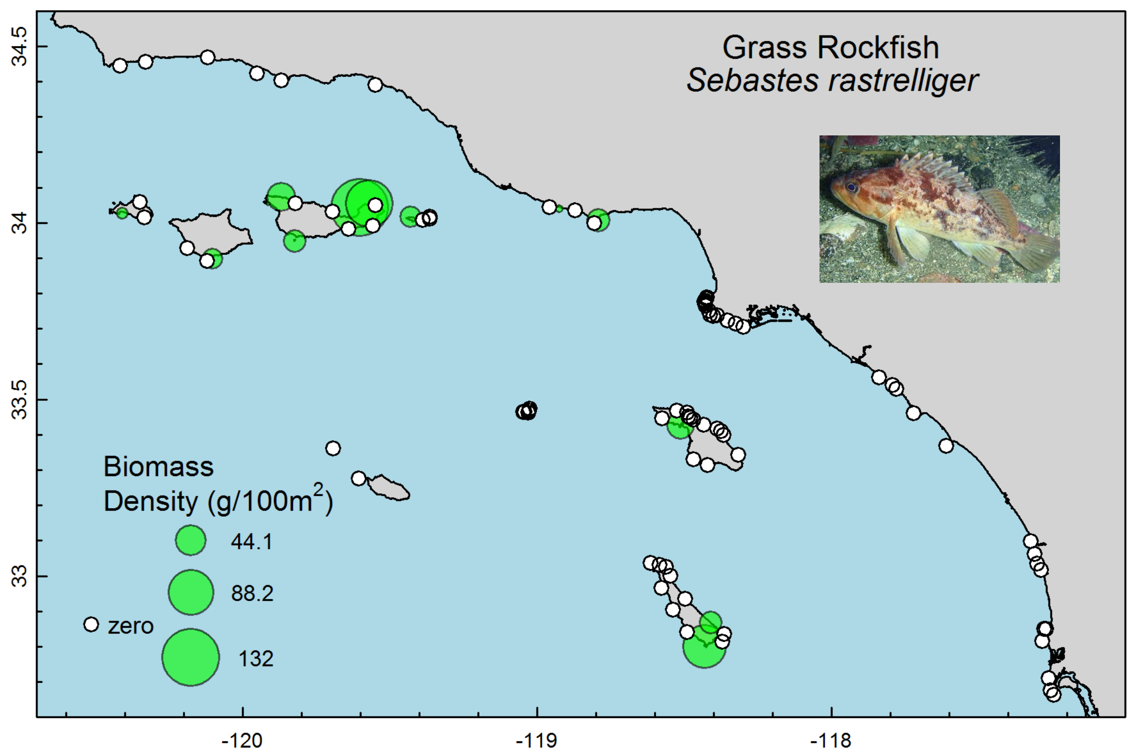


Figure C.18. Geographic distribution of *Sebastes rastrelliger* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

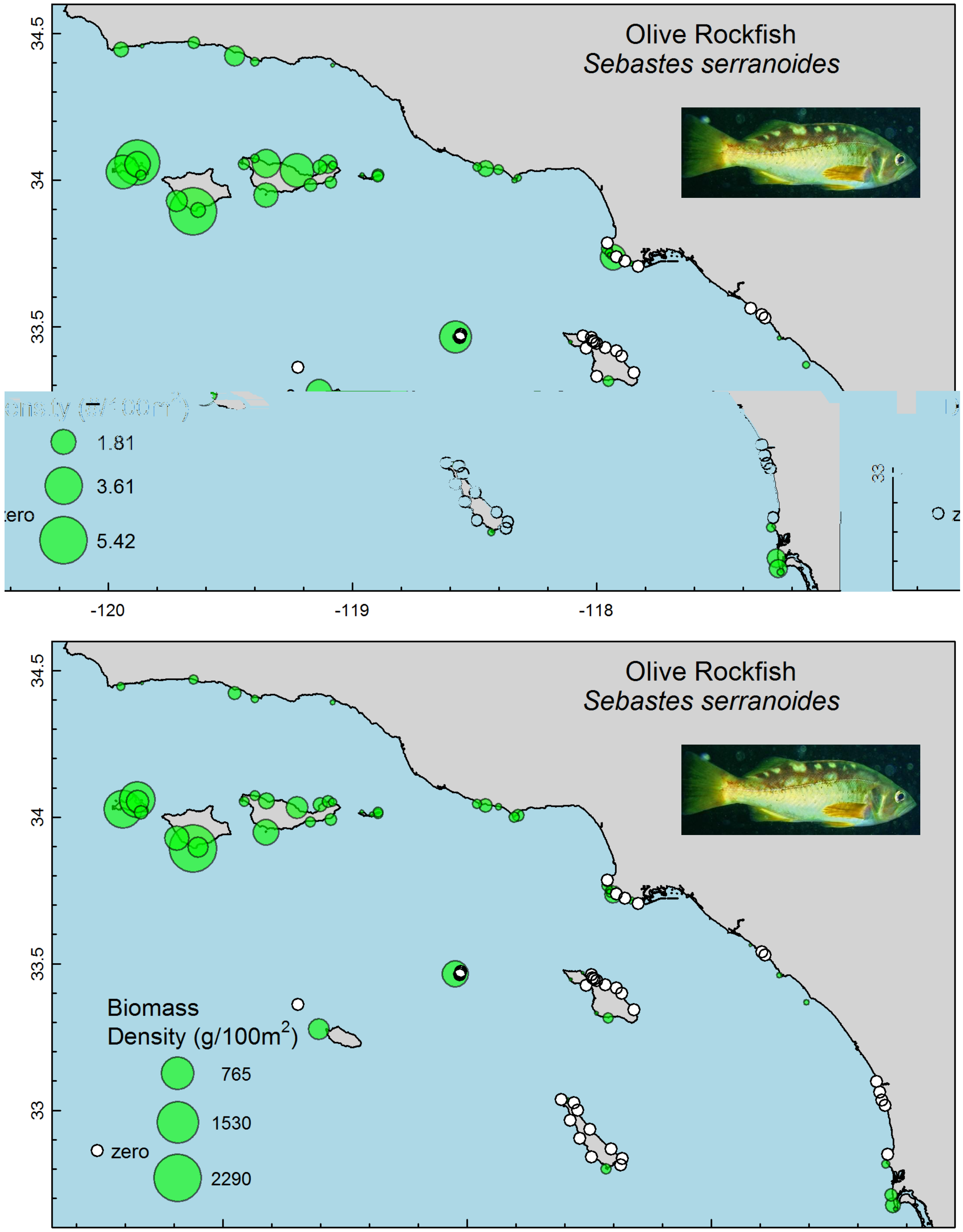


Figure C.19. Geographic distribution of *Sebastes serranoides* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

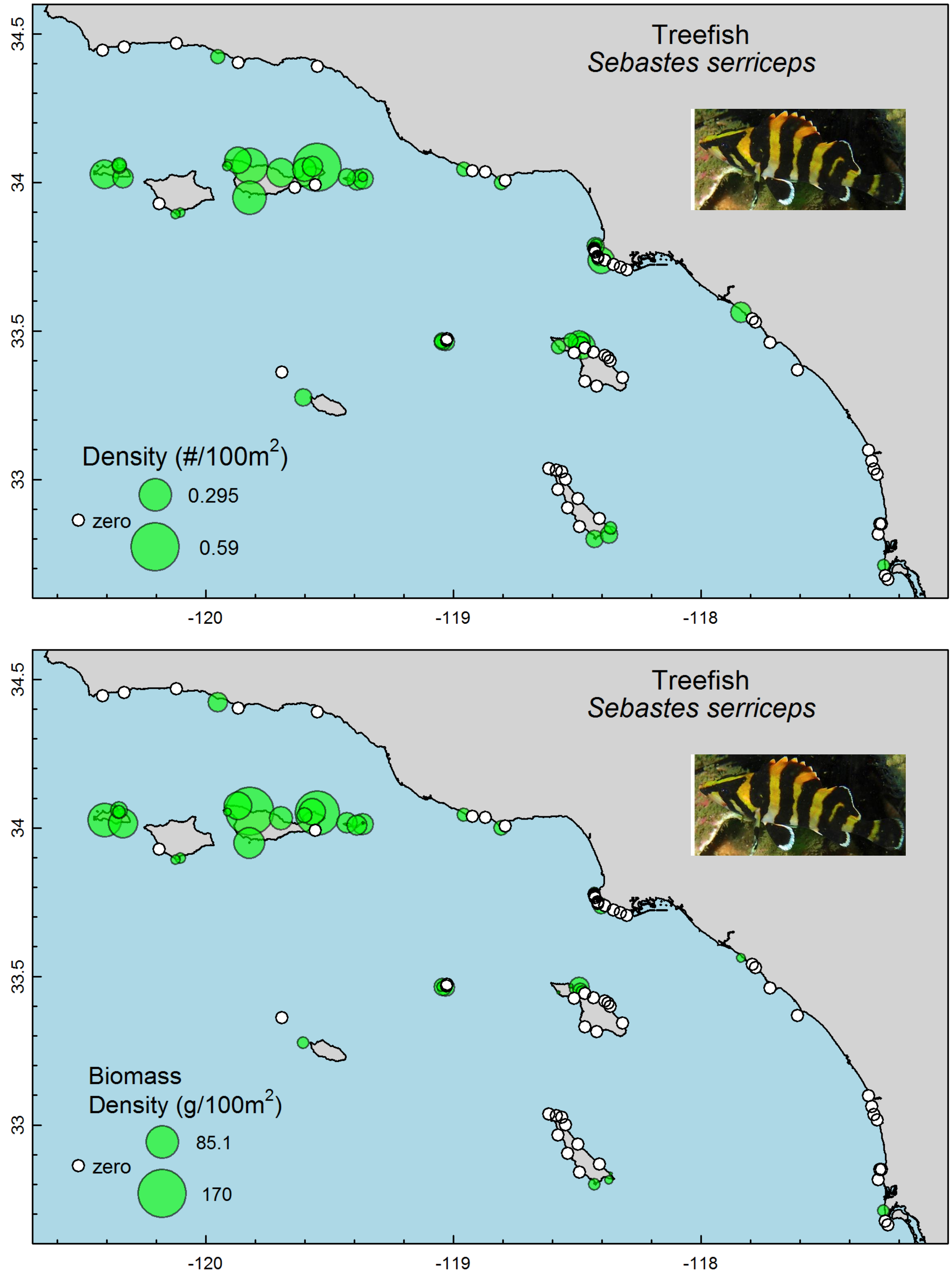


Figure C.20. Geographic distribution of *Sebastes serriceps* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

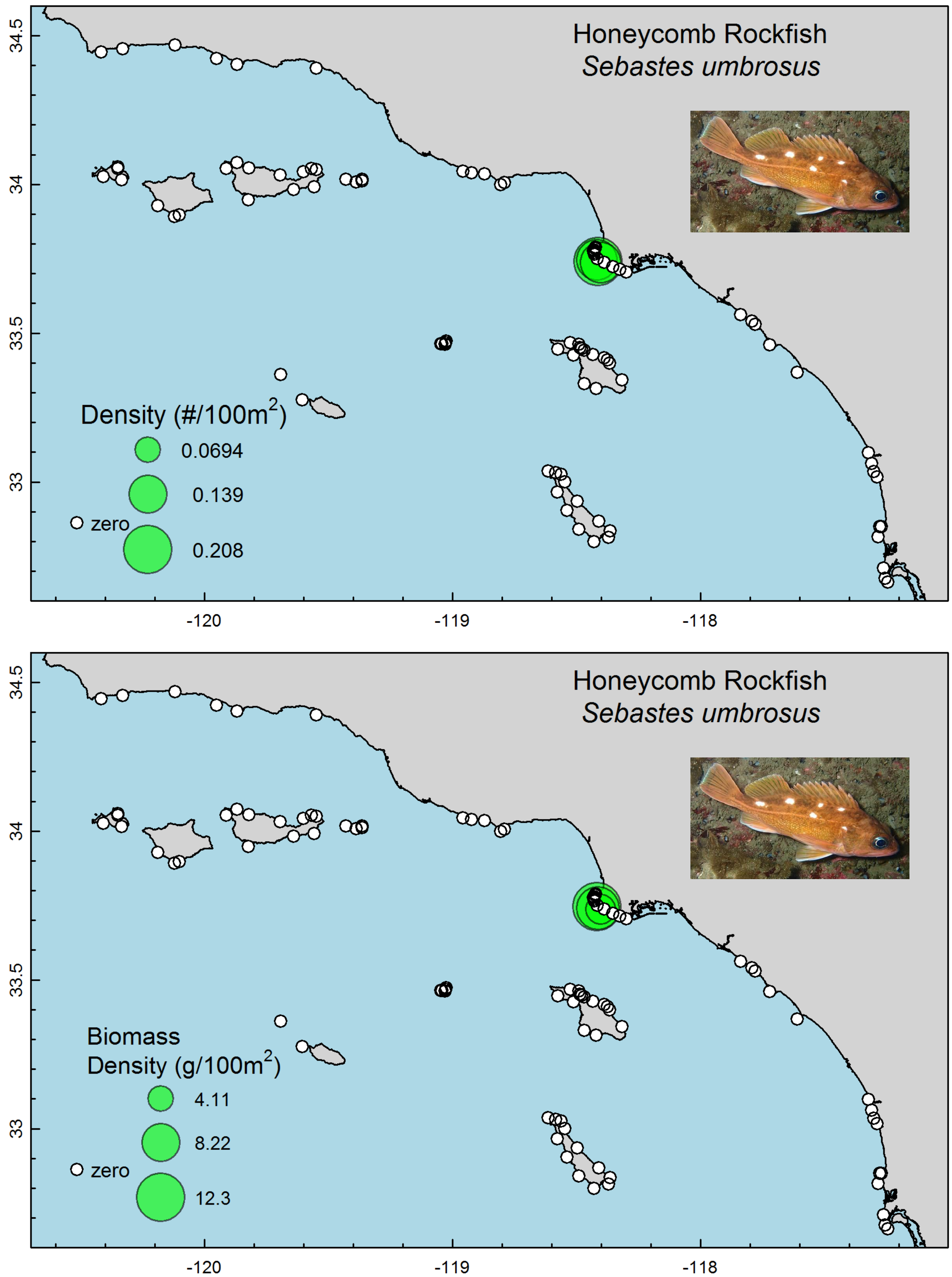


Figure C.21. Geographic distribution of *Sebastes umbrosus* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

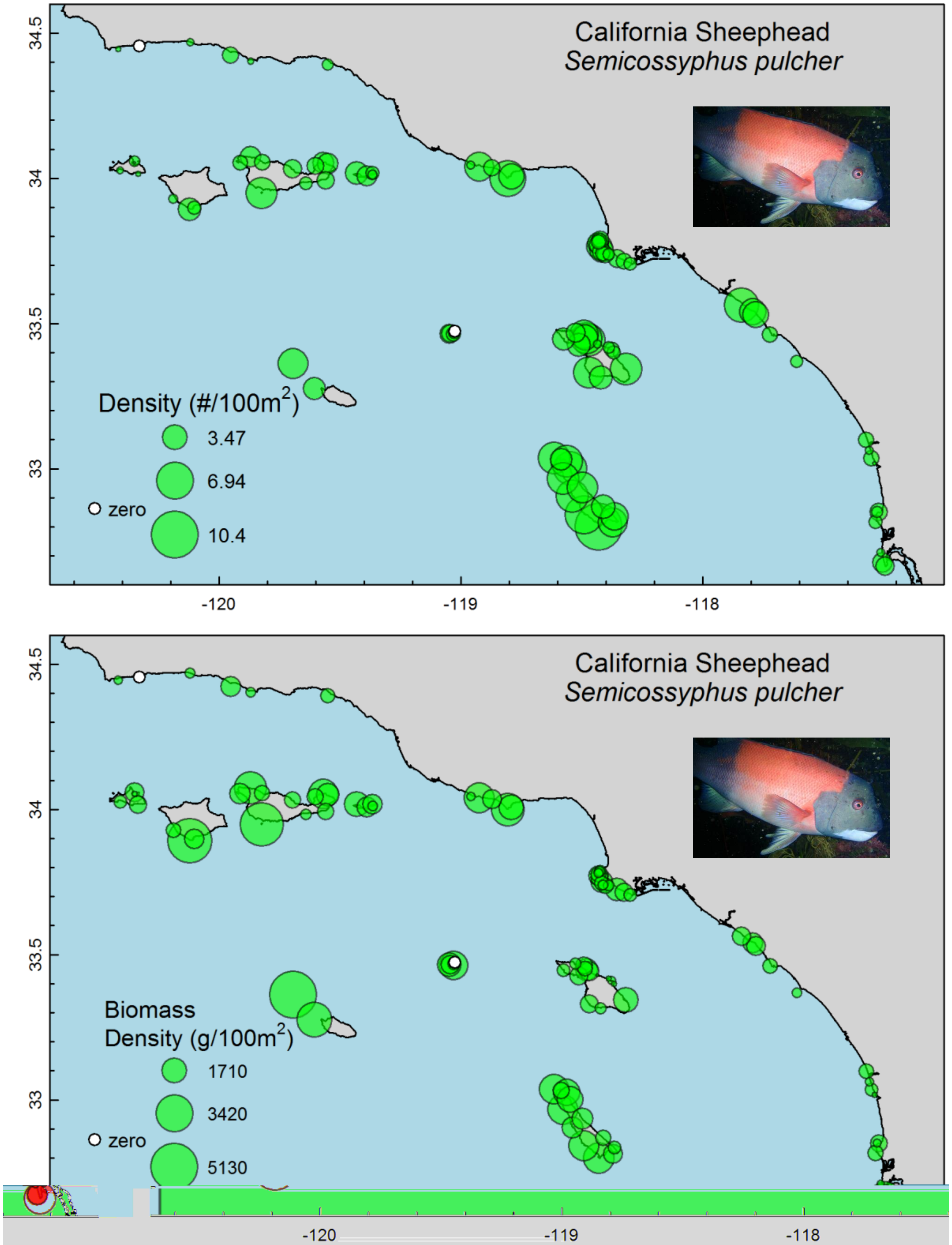
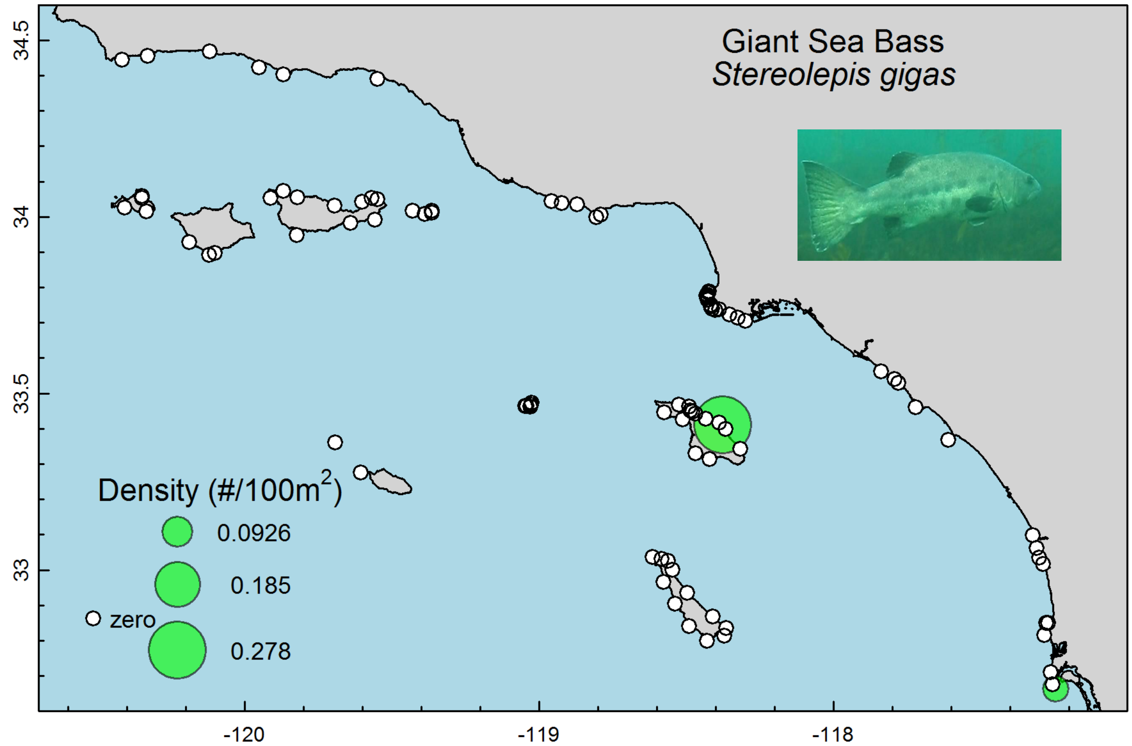


Figure C.22. Geographic distribution of *Semicossyphus pulcher* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.



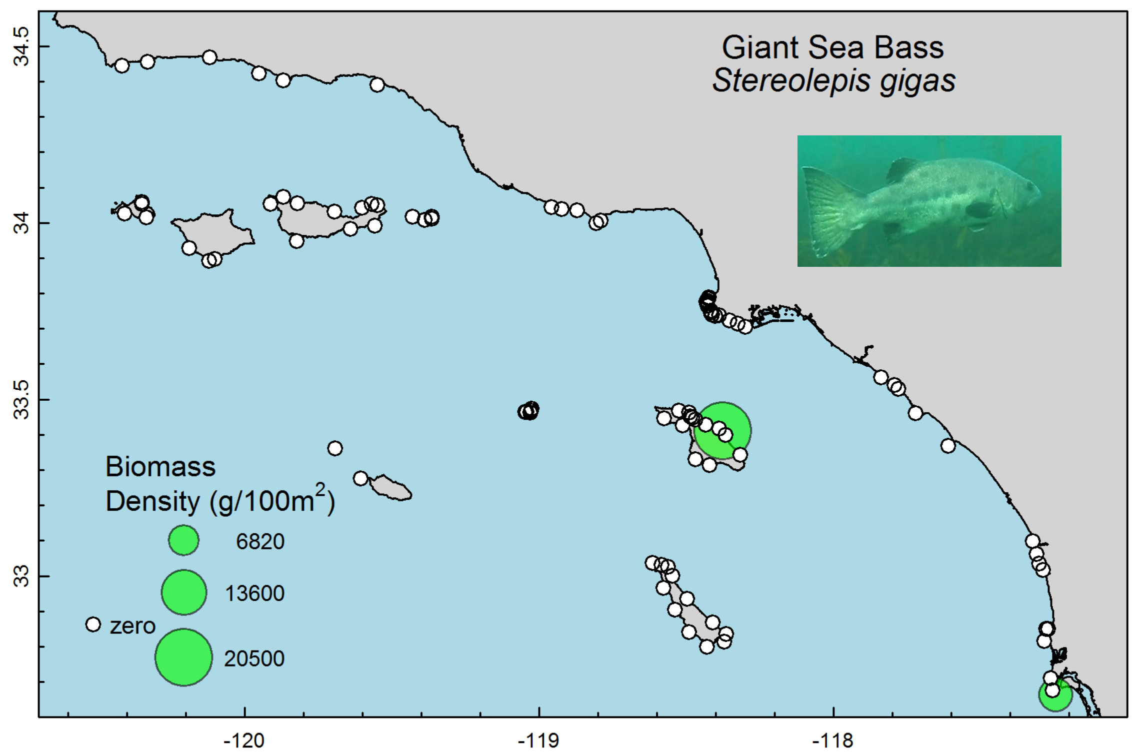
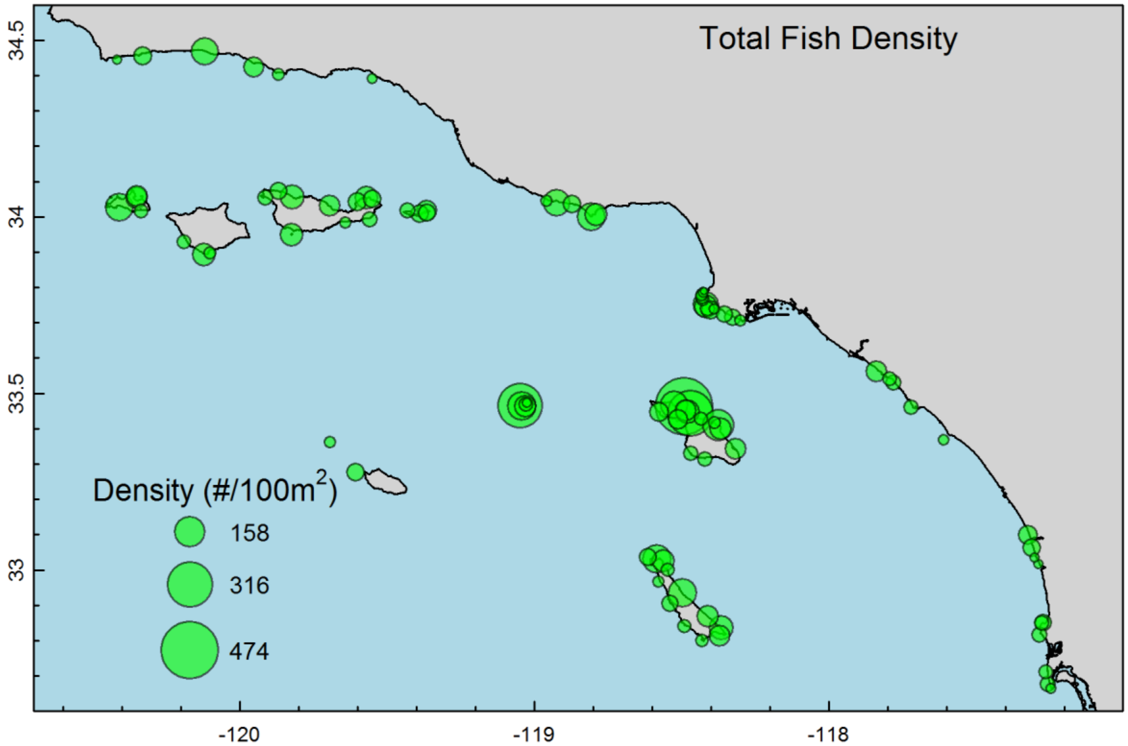


Figure C.23. Geographic distribution of *Stereolepis gigas* with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.



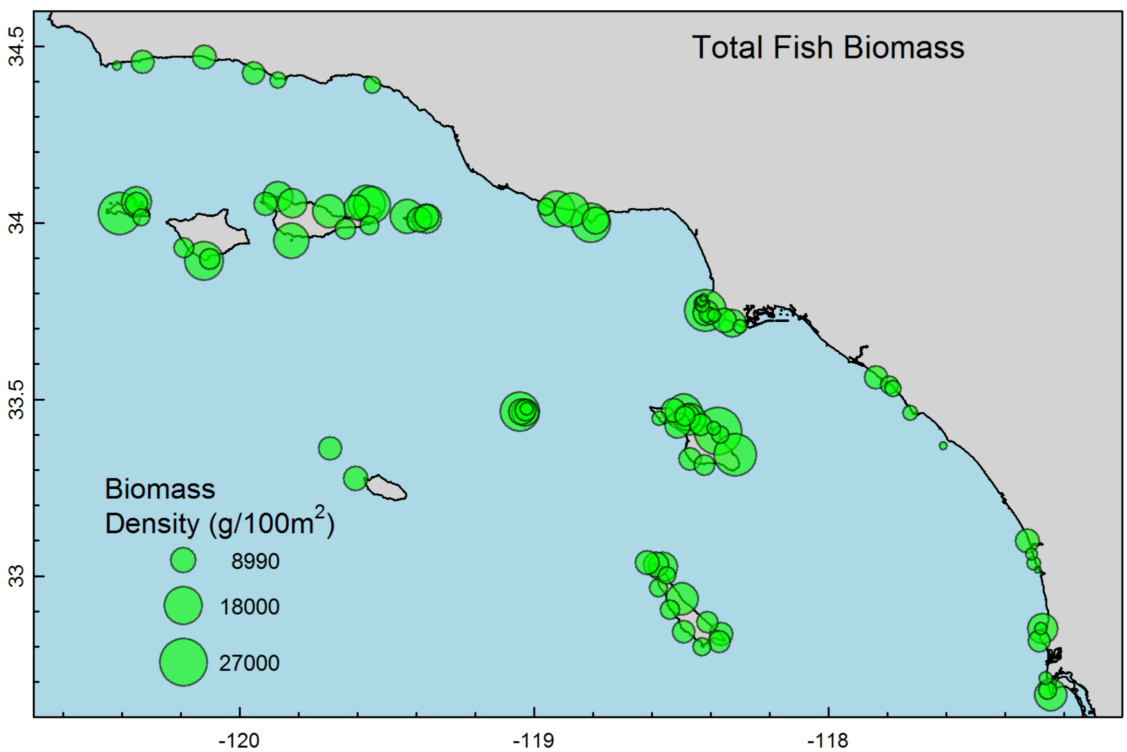


Figure C.24. Geographic distribution of total fish with the size of each green circle scaled to the numerical density (above) and biomass density (below). Site means were averaged across 2011 and 2012.

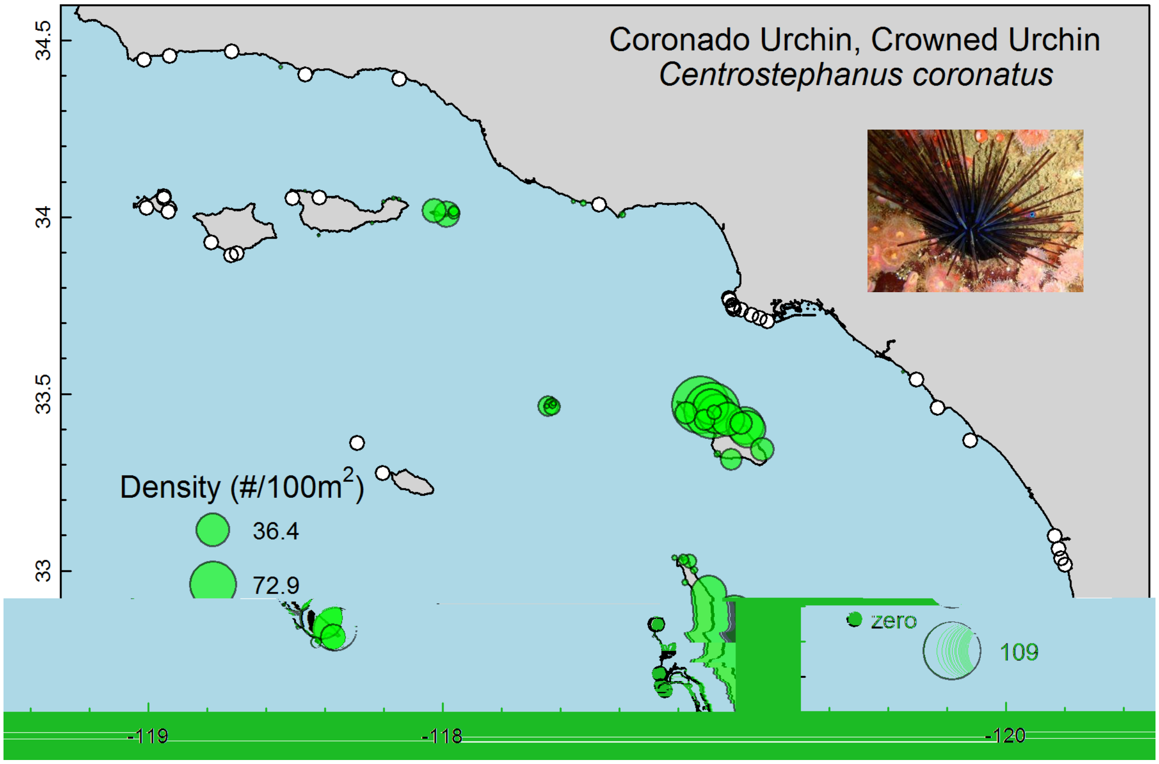


Figure C.25. Geographic distribution of *Centrostephanus coronatus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

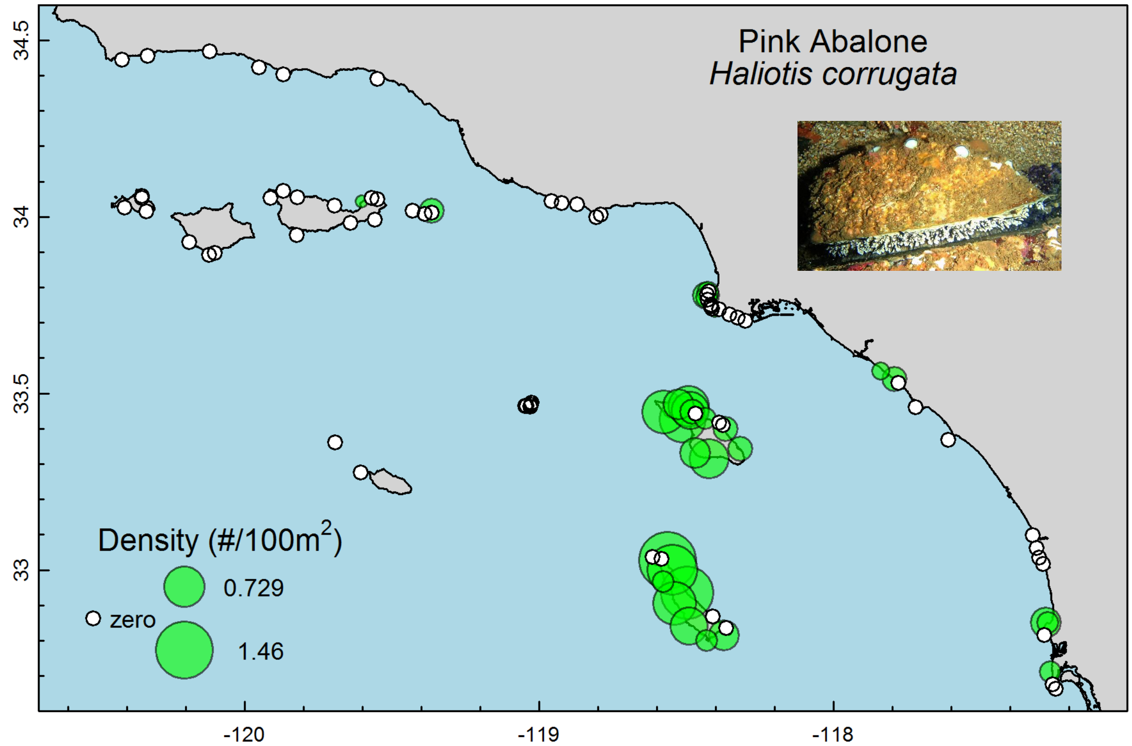


Figure C.26. Geographic distribution of *Haliotis corrugata* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

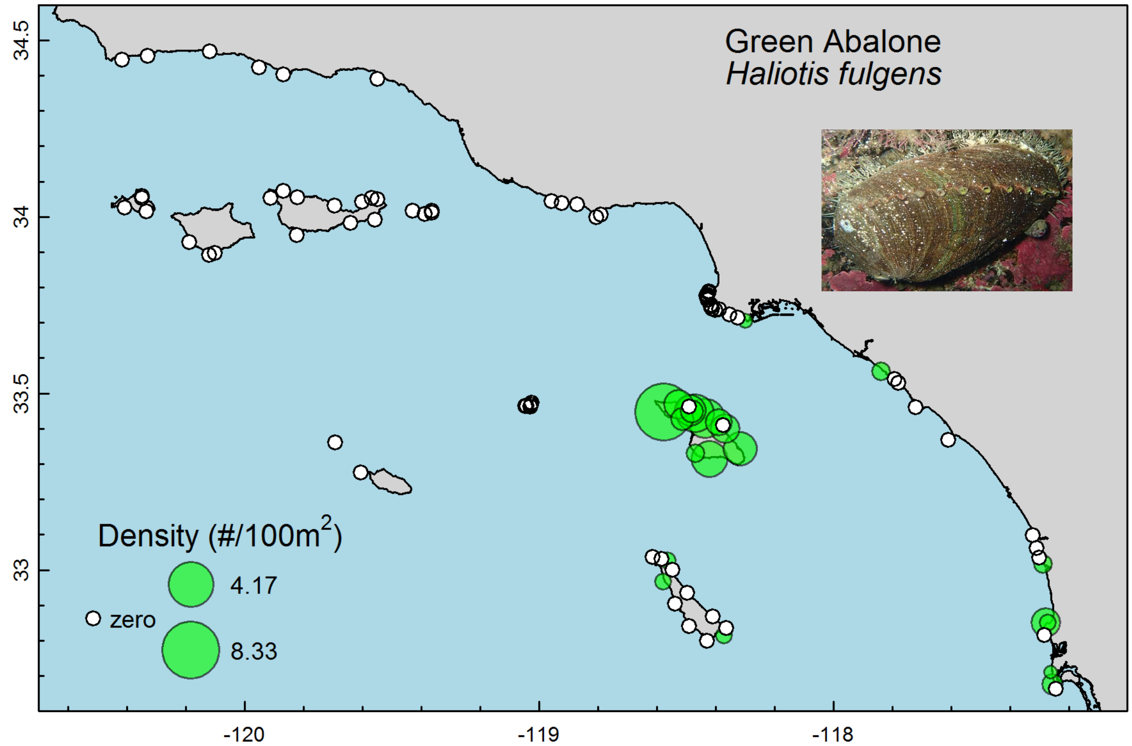


Figure C.27. Geographic distribution of *Haliotis fulgens* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

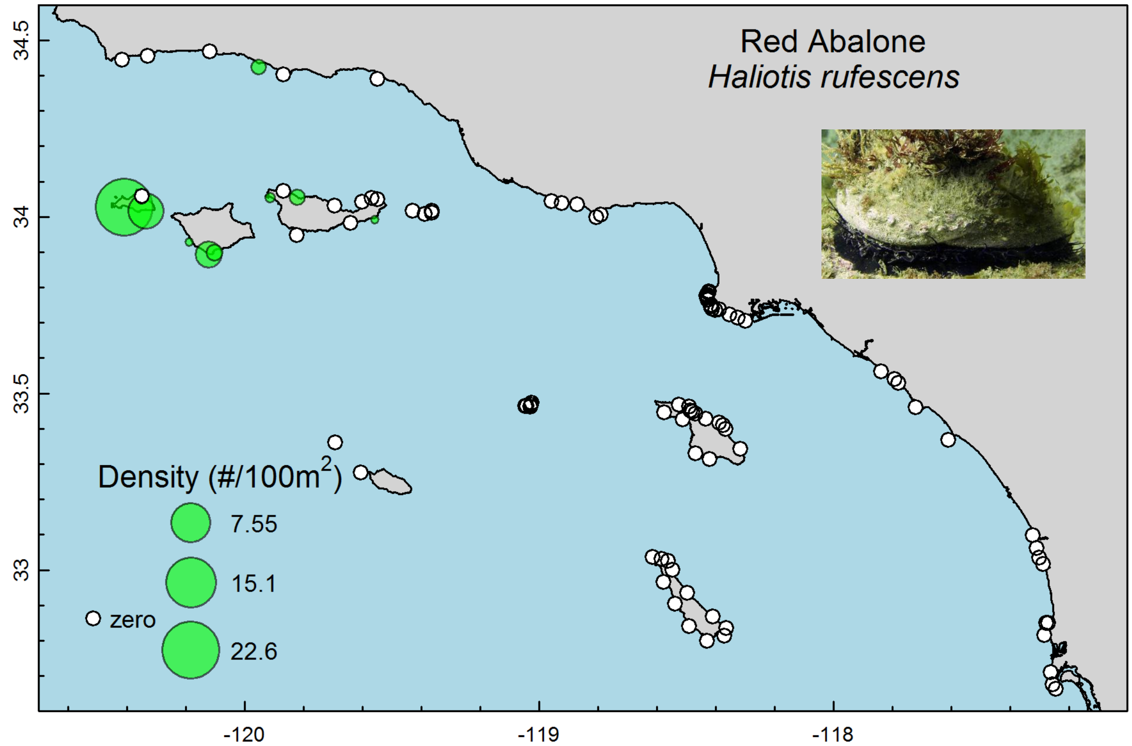


Figure C.28. Geographic distribution of *Haliotis rufescens* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

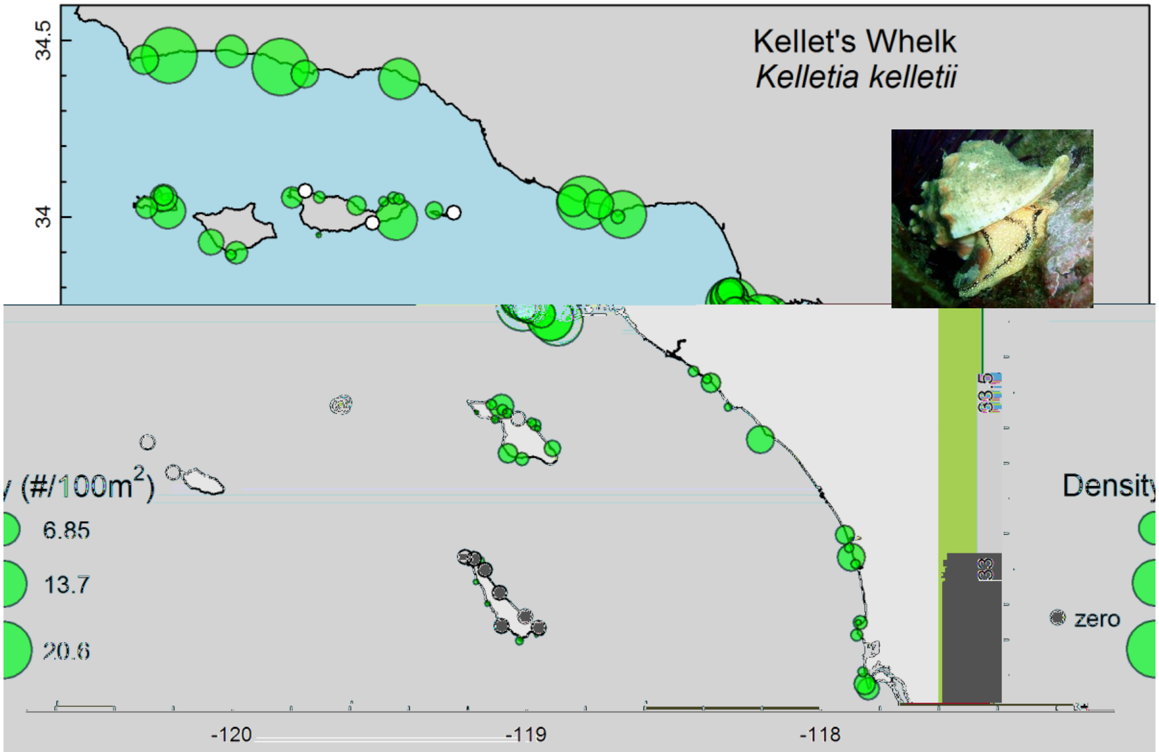


Figure C.29. Geographic distribution of *Kelletia kelletii* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

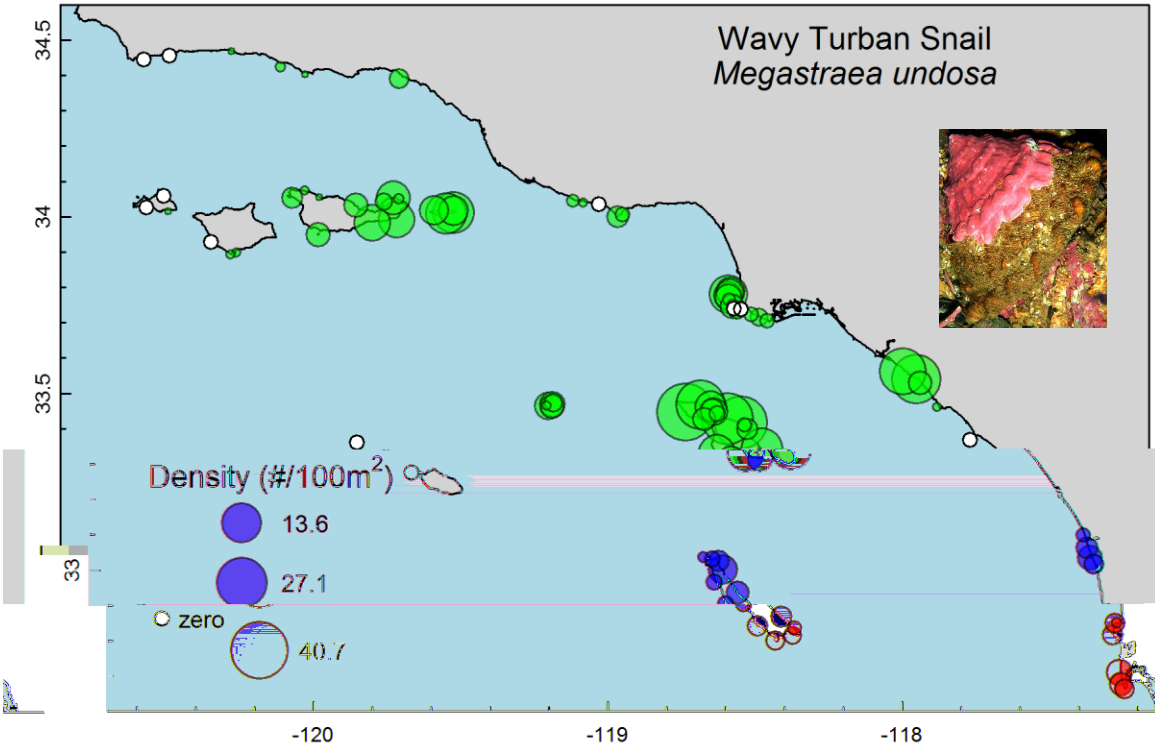


Figure C.30. Geographic distribution of *Megastrea undosa* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

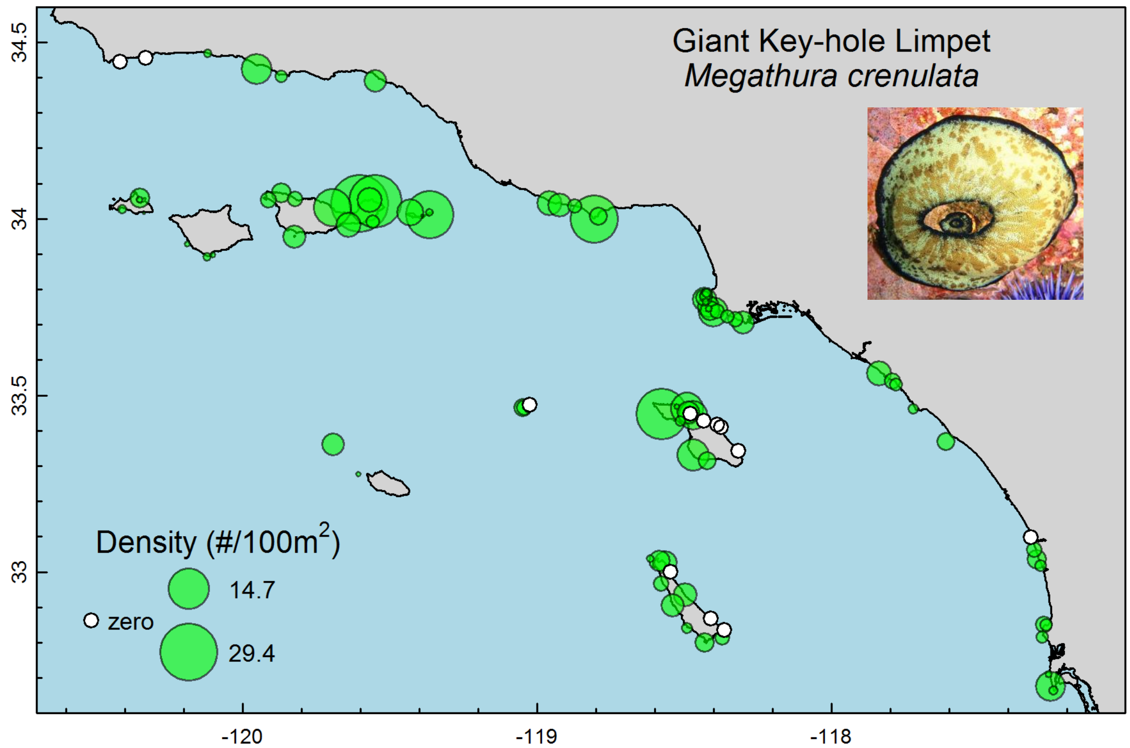


Figure C.31. Geographic distribution of *Megathura crenulata* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

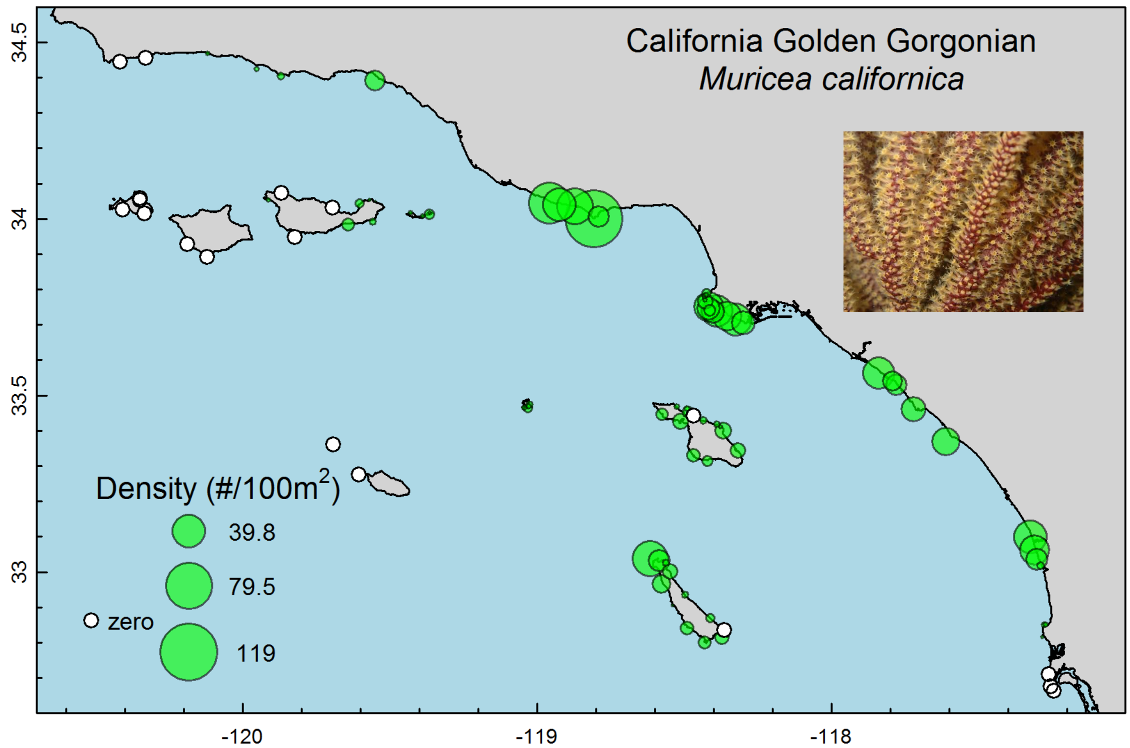


Figure C.32. Geographic distribution of *Muricea californica* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

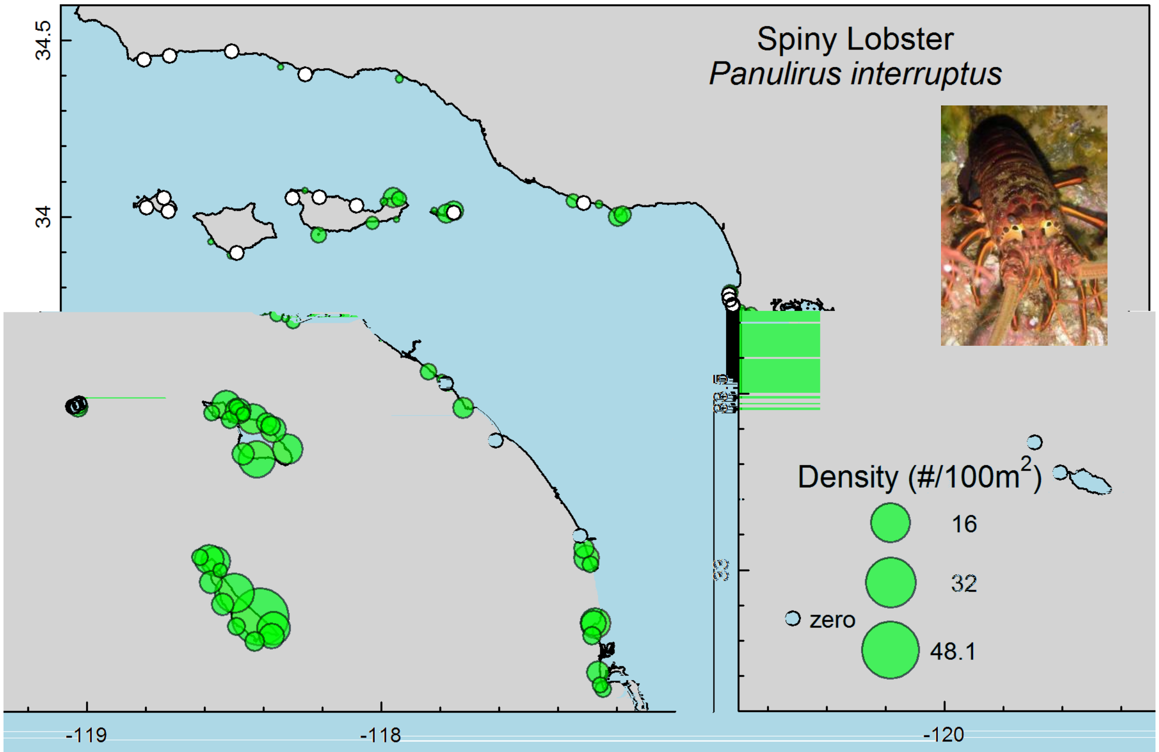


Figure C.33. Geographic distribution of *Panulirus interruptus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

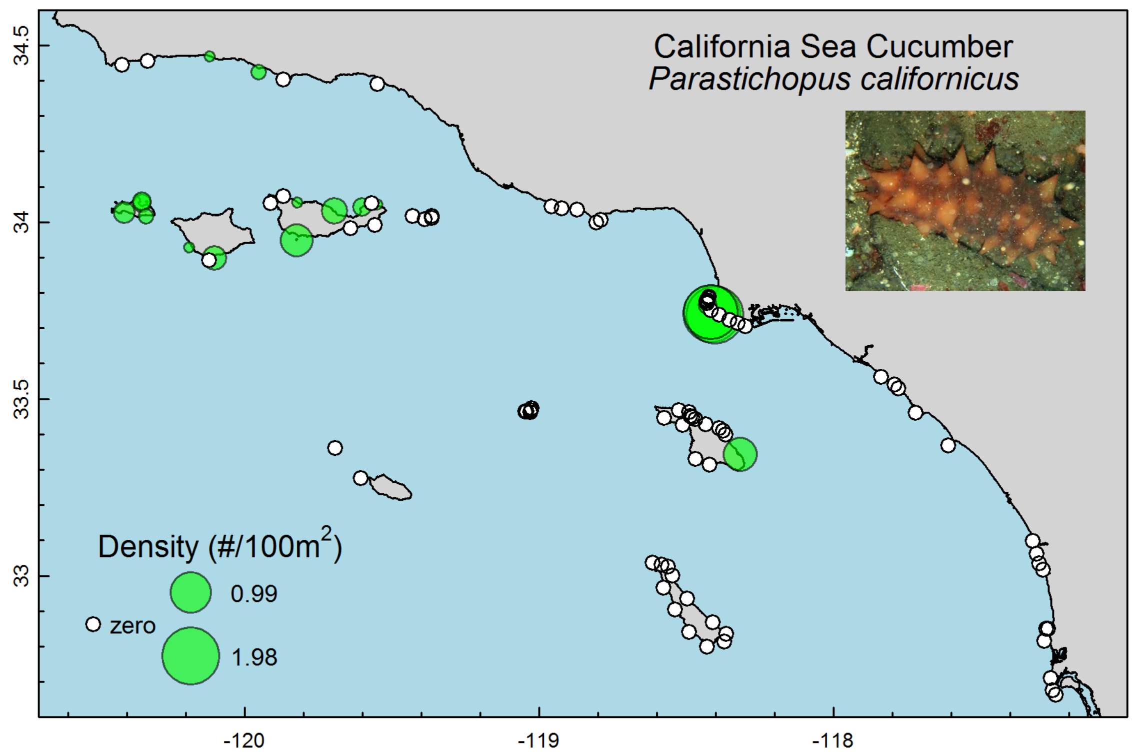


Figure C.34. Geographic distribution of *Parastichopus californicus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

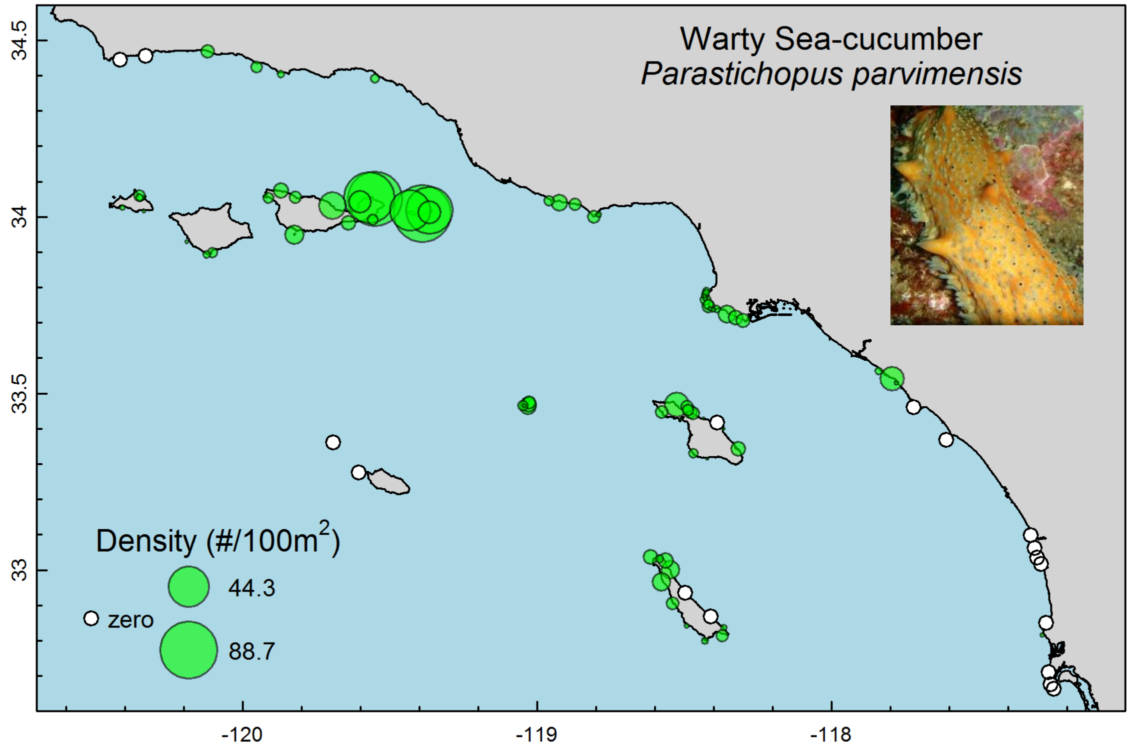


Figure C.35. Geographic distribution of *Parastichopus parvimensis* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

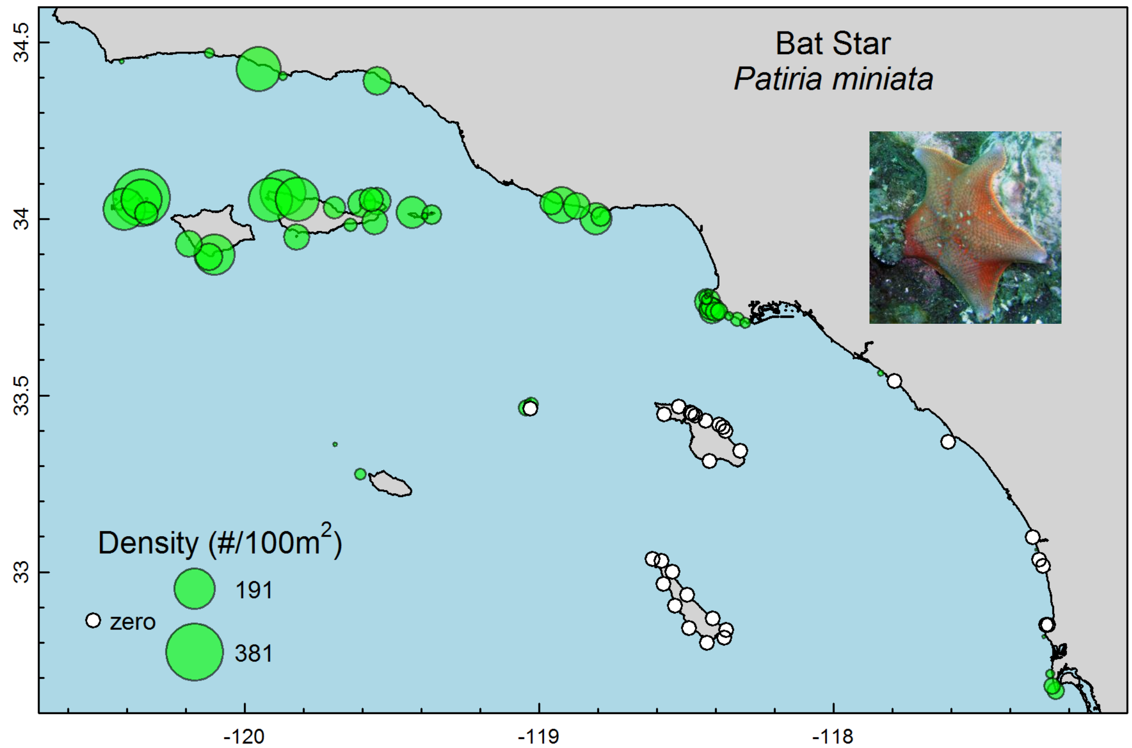


Figure C.36. Geographic distribution of *Patira miniata* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

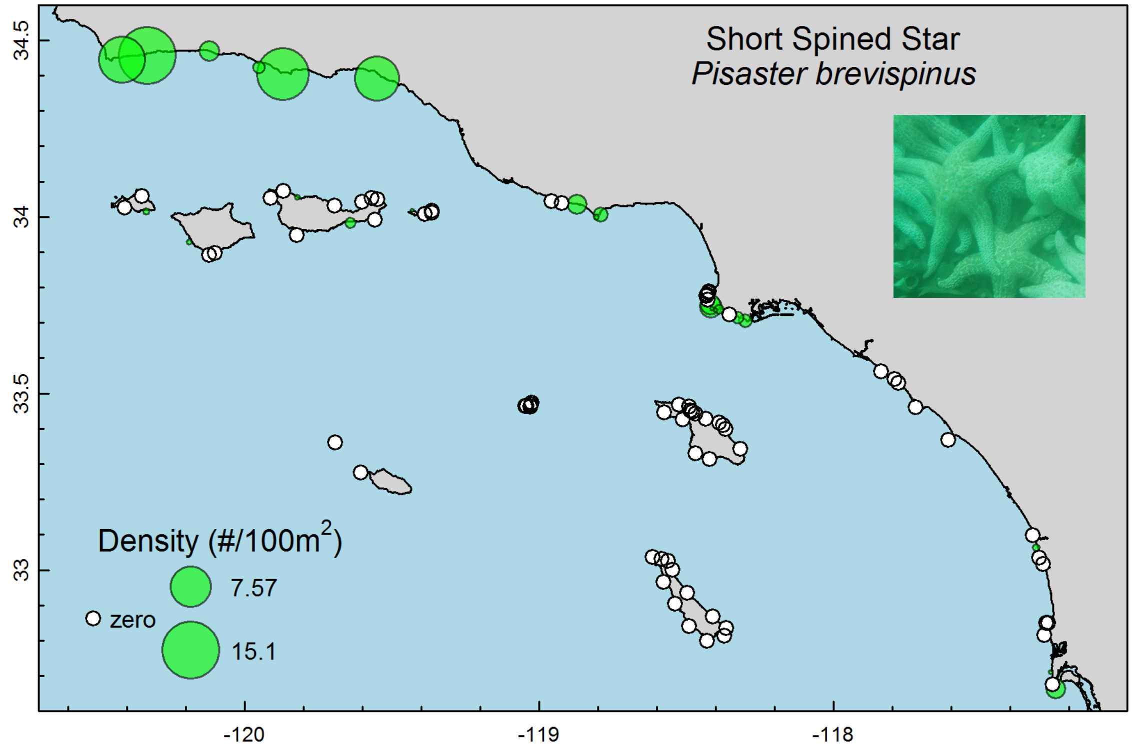


Figure C.37. Geographic distribution of *Pisaster brevispinus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

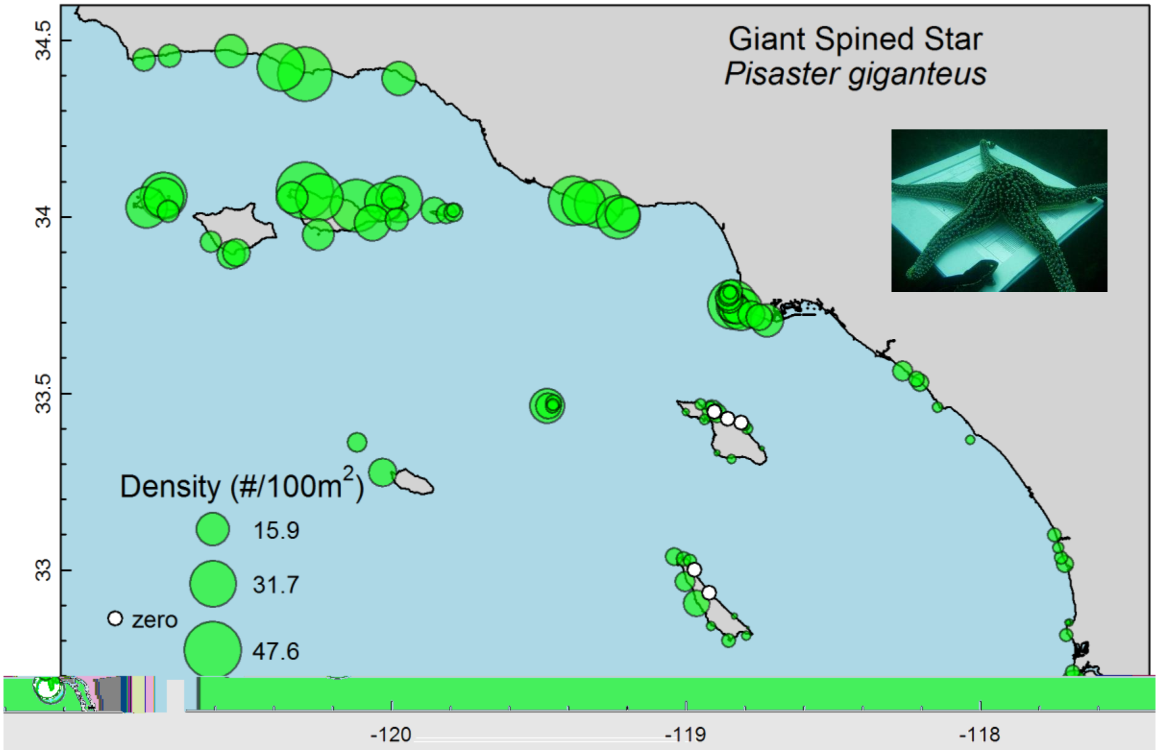


Figure C.38. Geographic distribution of *Pisaster giganteus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

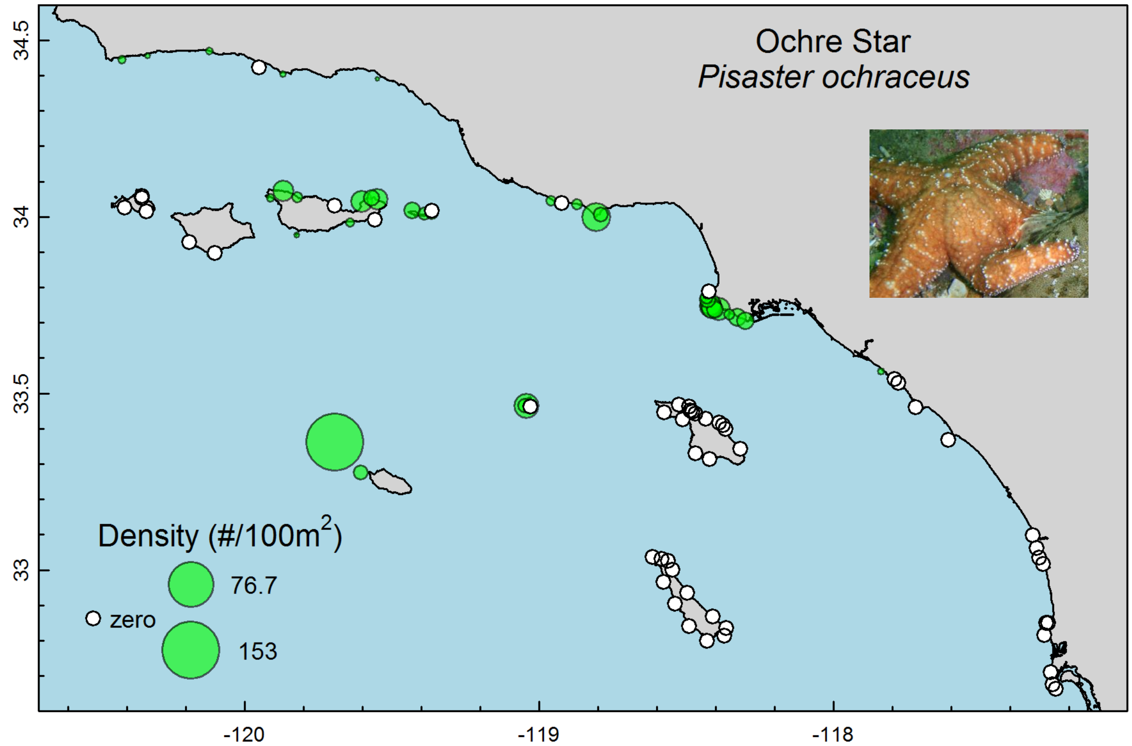


Figure C.39. Geographic distribution of *Pisaster ochraceus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

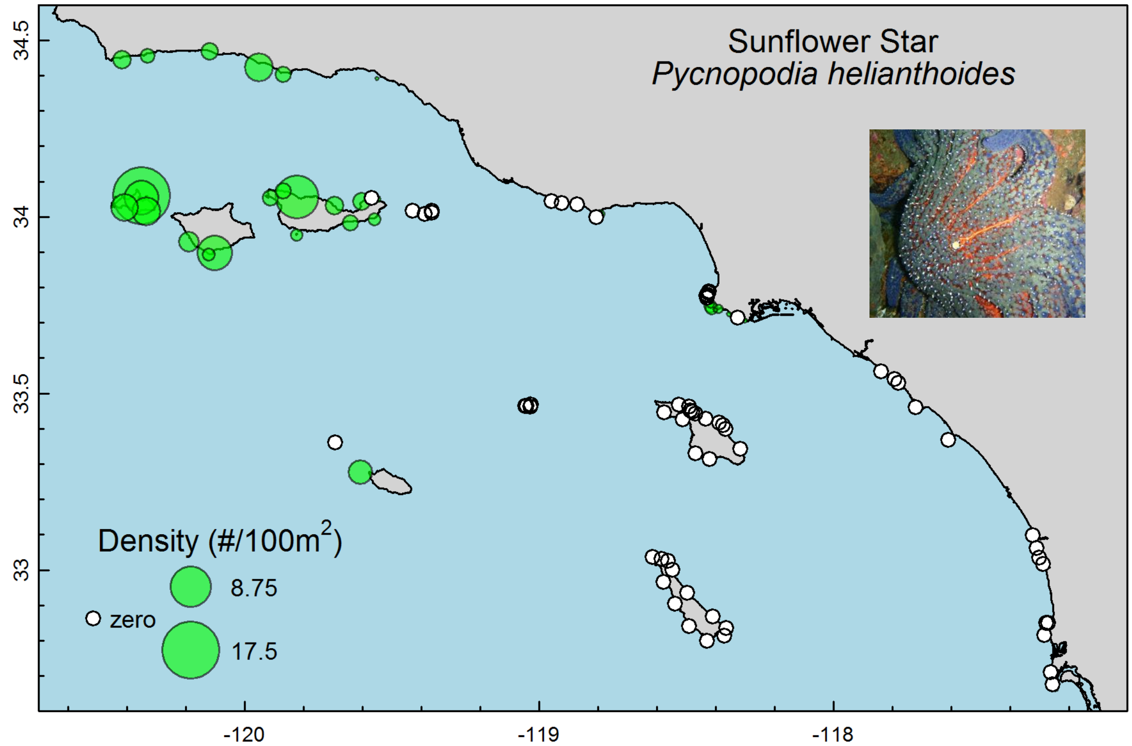


Figure C.40. Geographic distribution of *Pycnopodia helianthoides* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

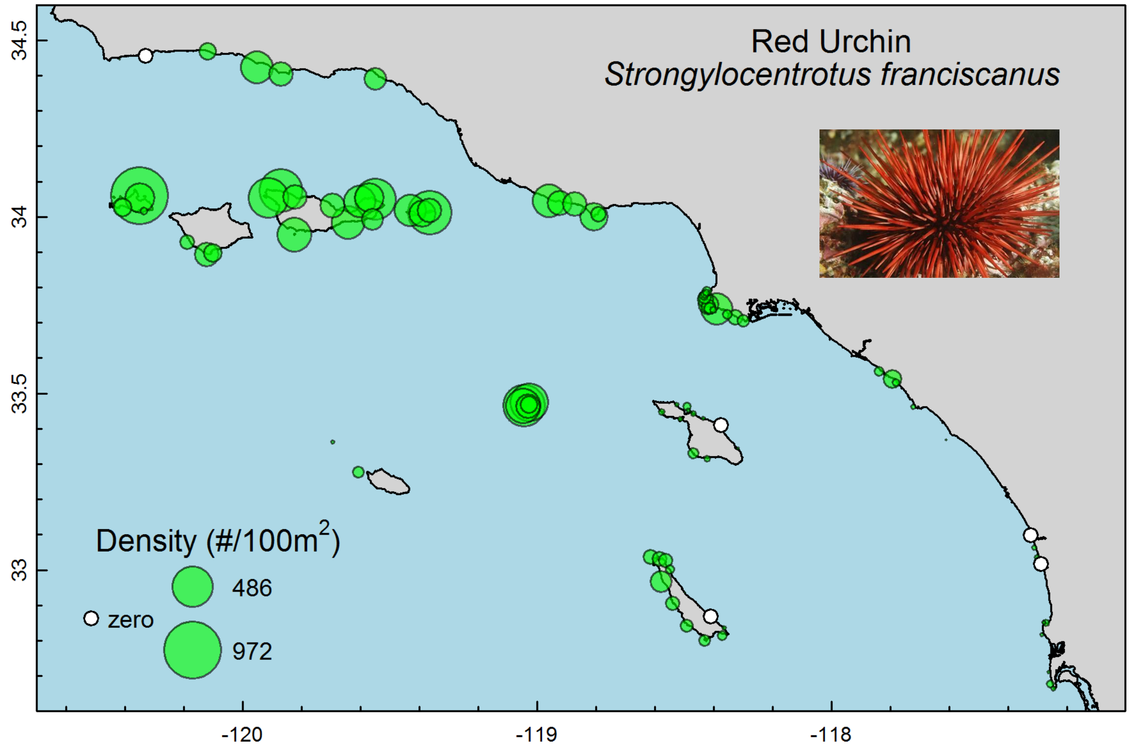


Figure C.41. Geographic distribution of *Strongylocentrotus franciscanus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

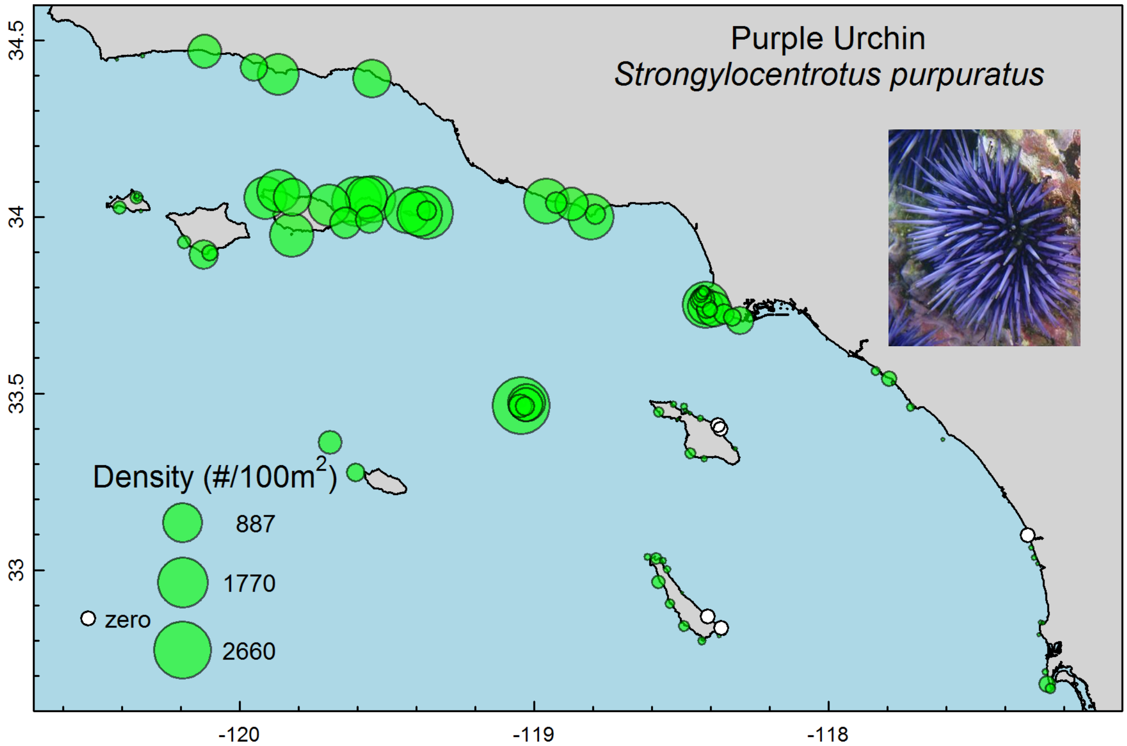


Figure C.42. Geographic distribution of *Strongylocentrotus purpuratus* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

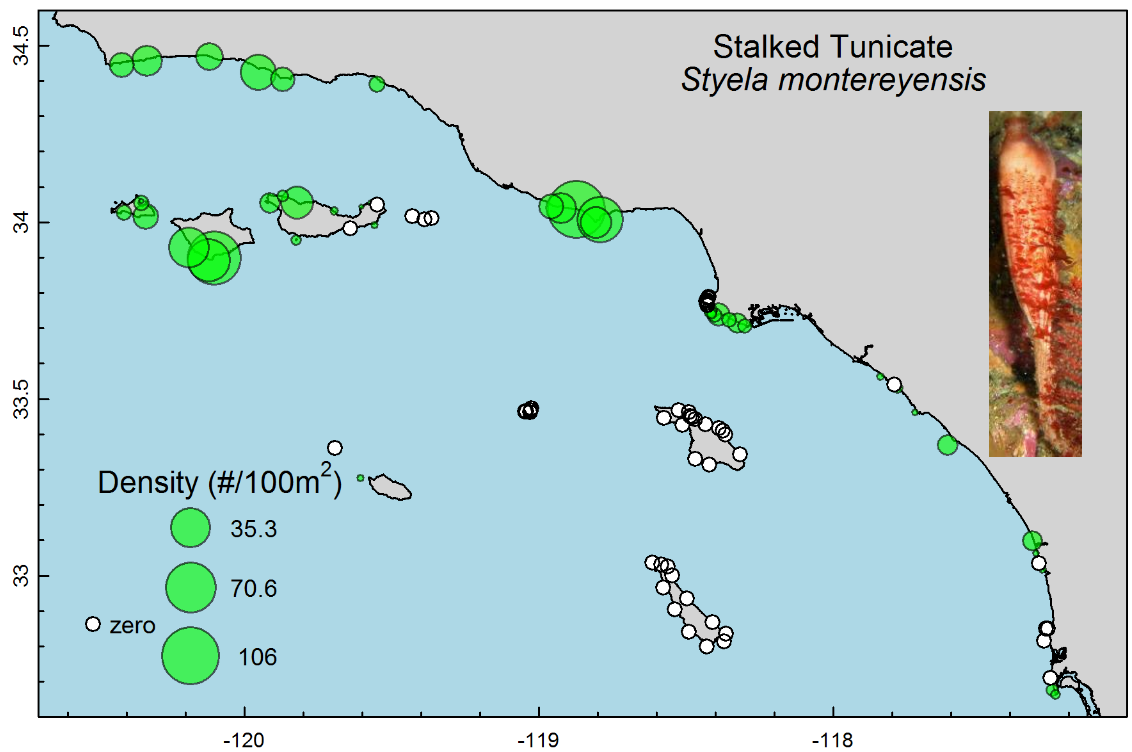


Figure C.43. Geographic distribution of *Styela montereyensis* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

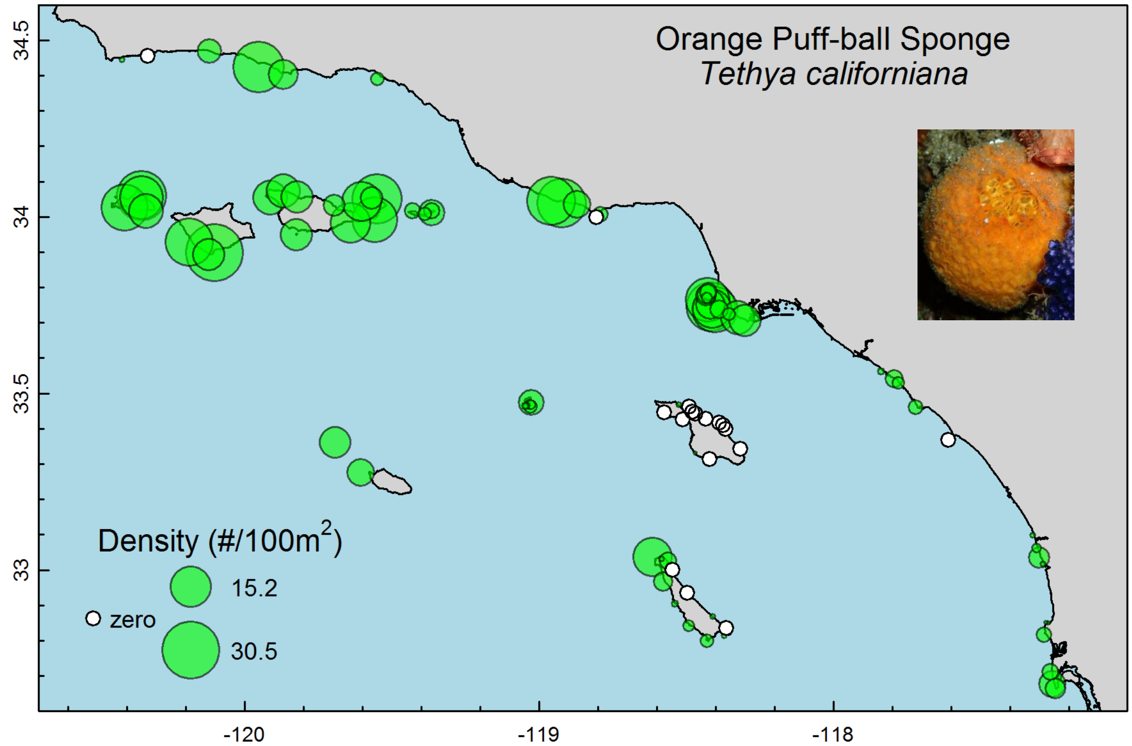


Figure C.44. Geographic distribution of *Tethya californiana* with the size of each green circle scaled to the numerical density. Site means were averaged across 2011 and 2012. Sites where the species was not observed are shown with a white circle.

Appendix D

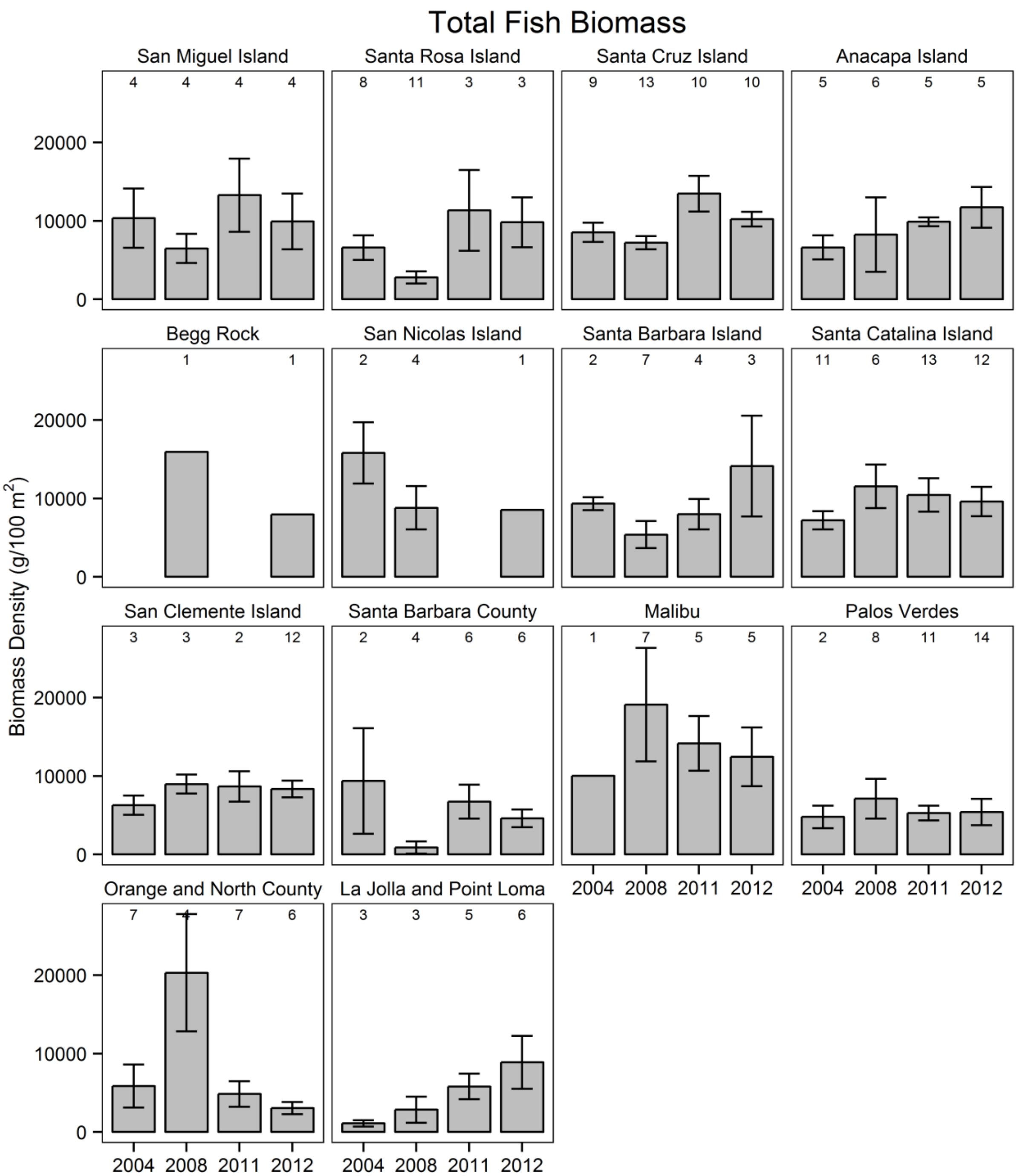


Figure D.1. Total fish biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

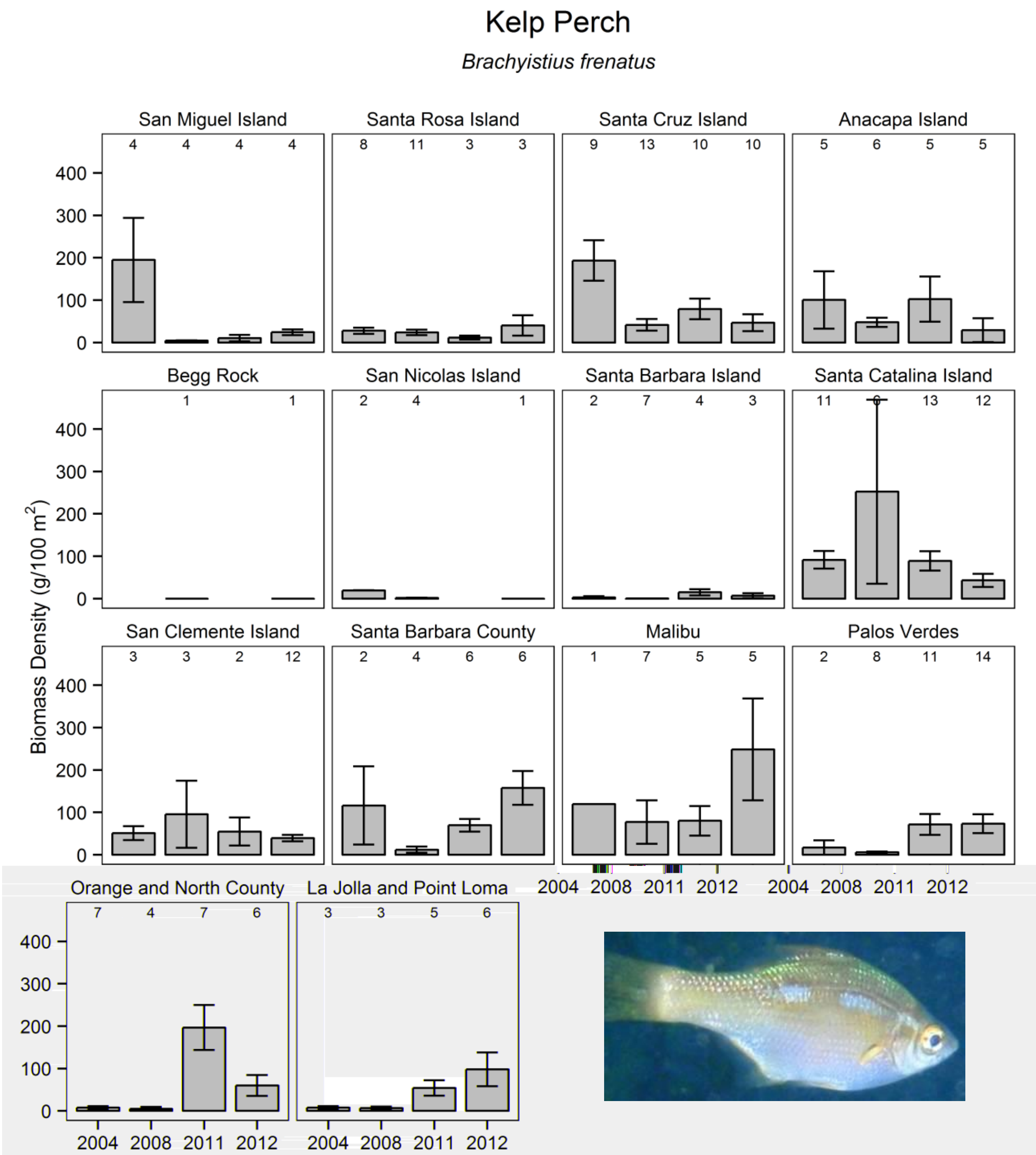


Figure D.2. *Brachyistius frenatus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

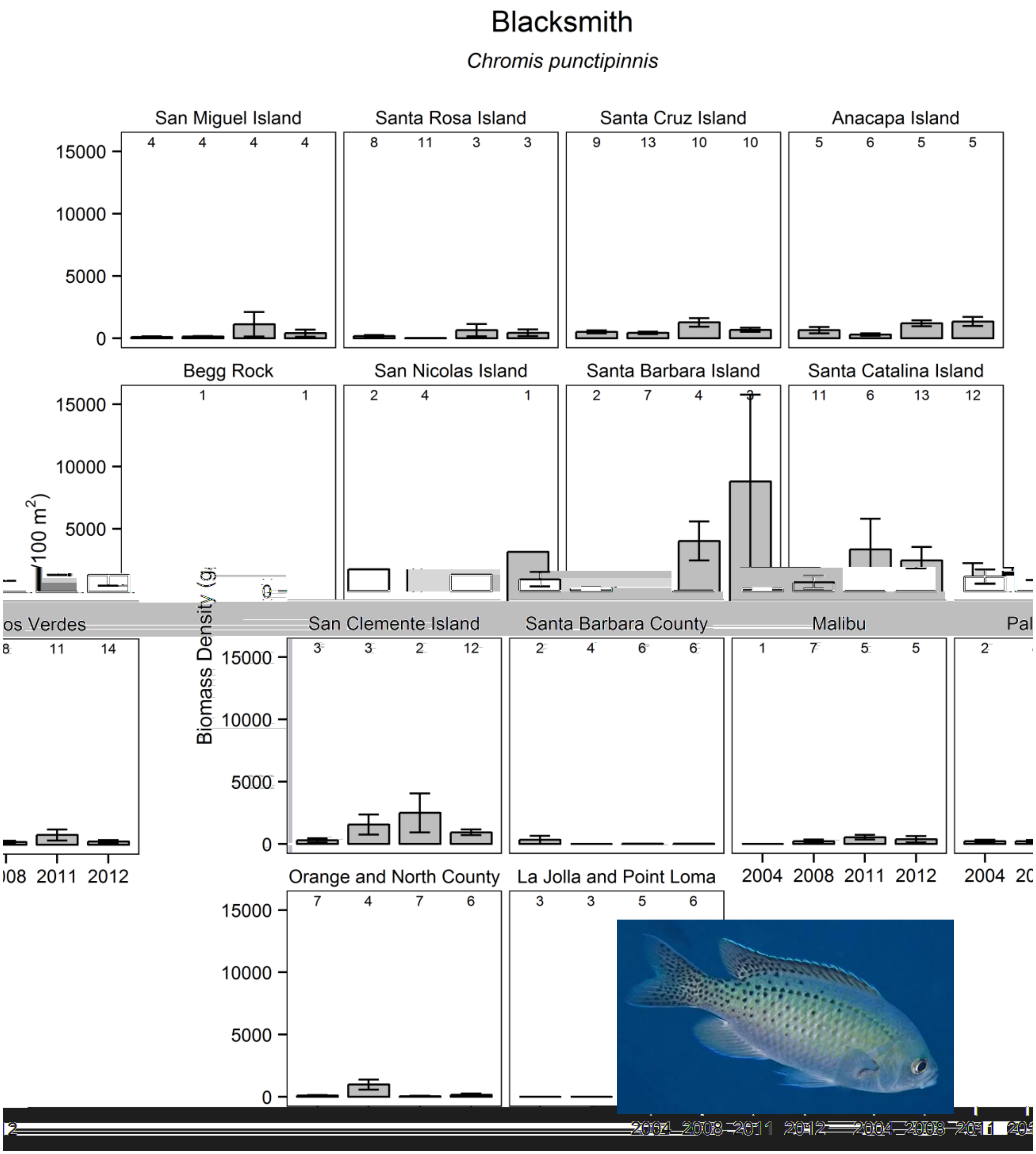


Figure D.3. *Chromis punctipinnis* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

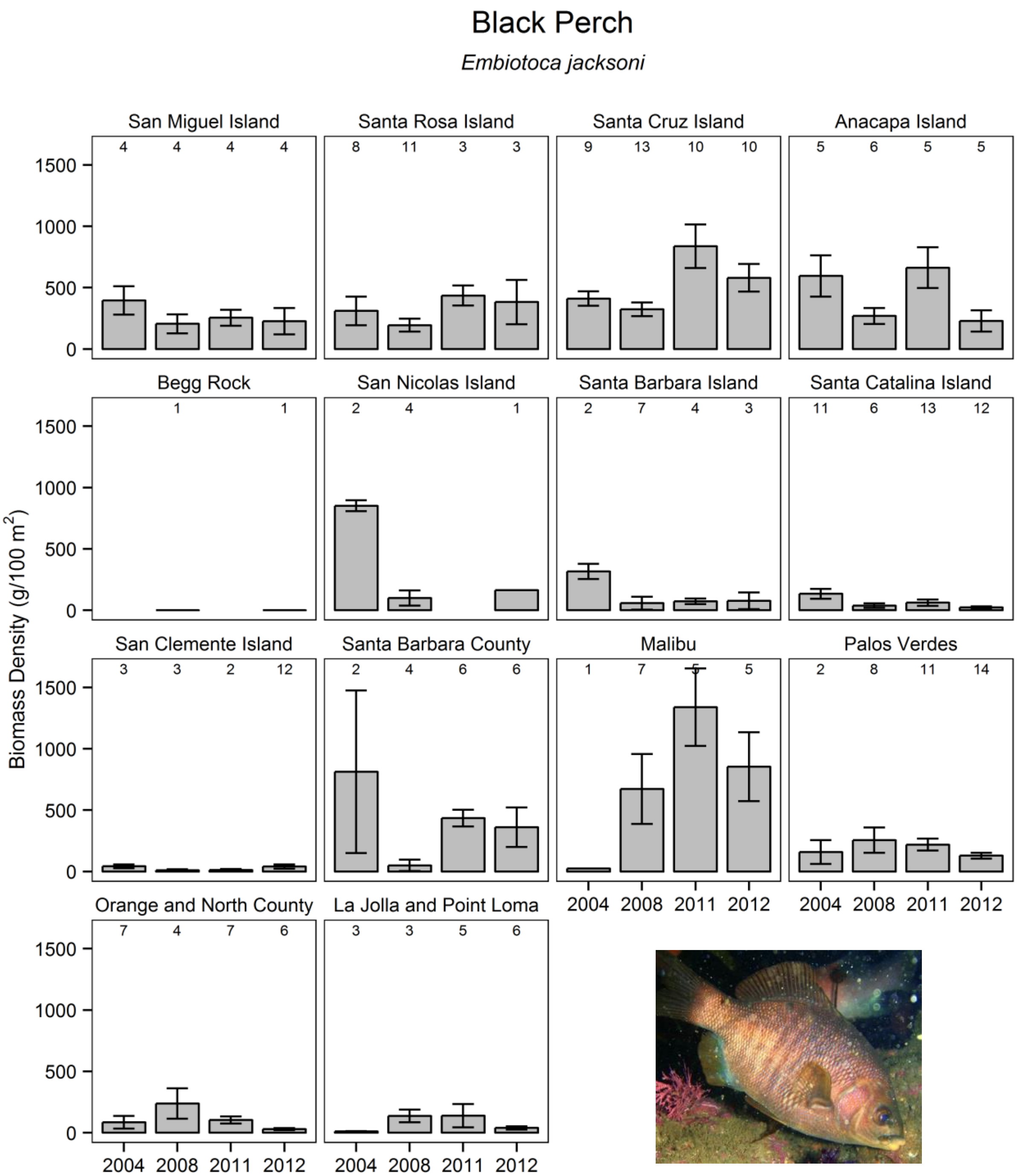


Figure D.4. *Embiotoca jacksoni* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

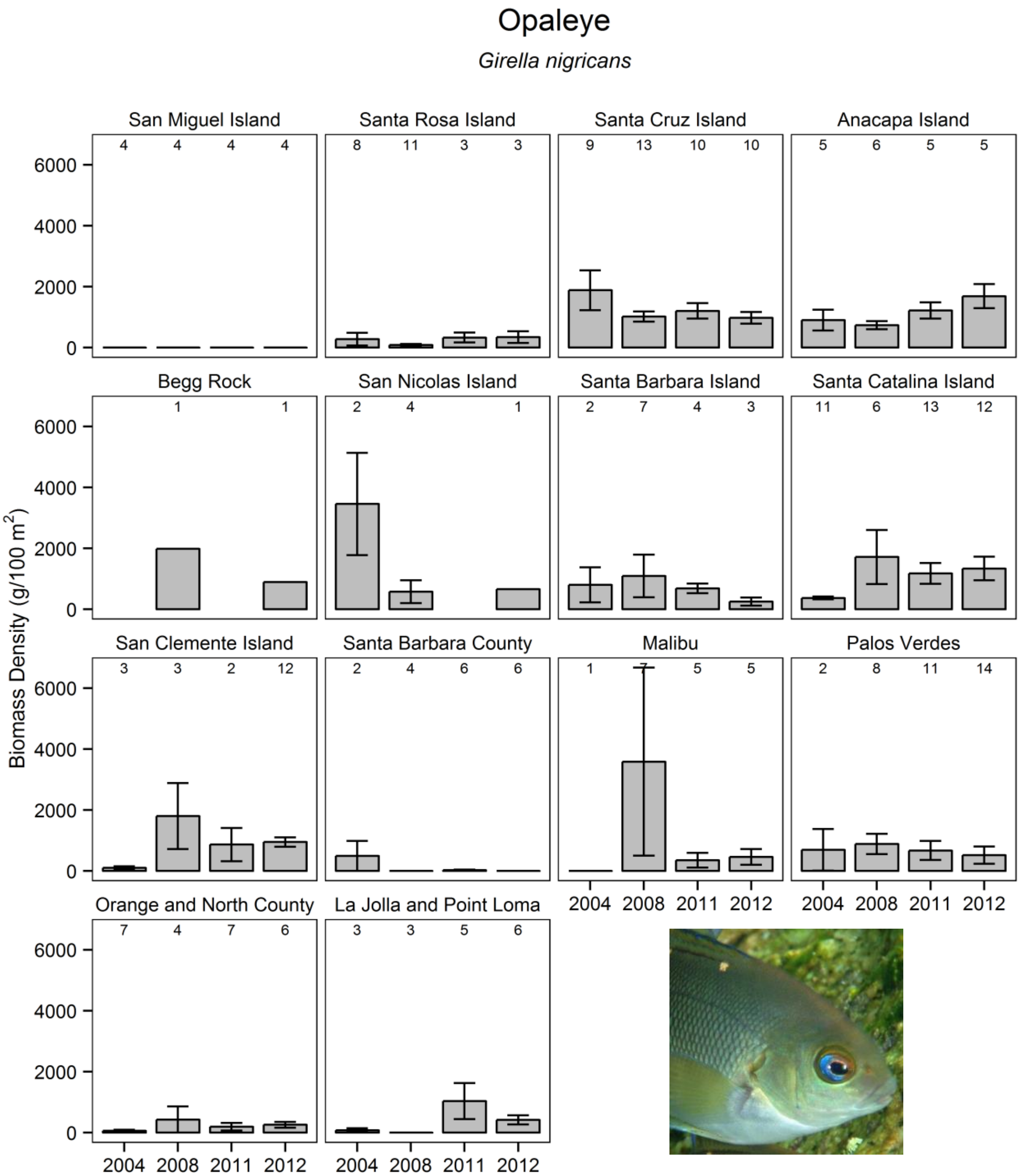


Figure D.5. *Girella nigricans* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

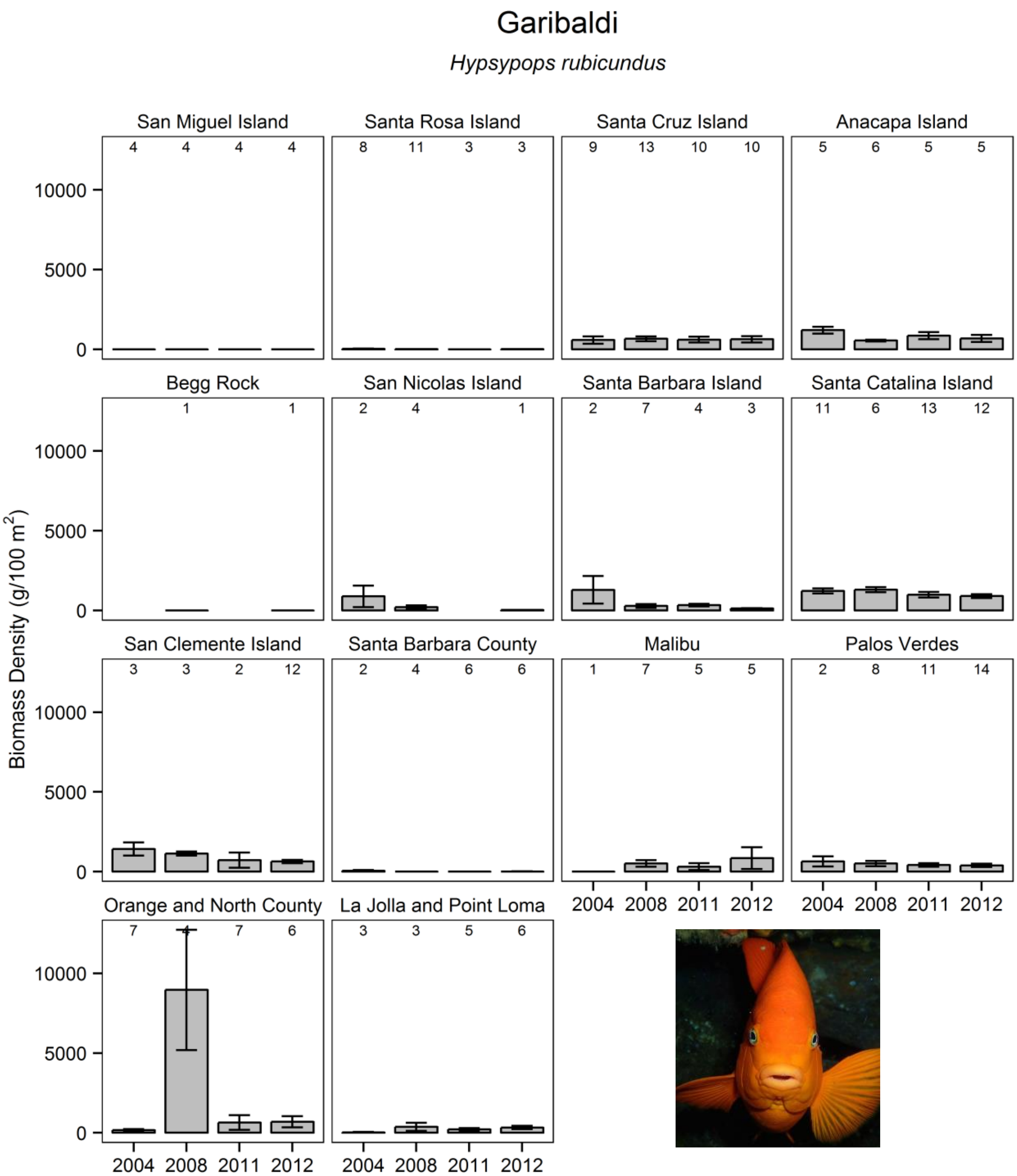


Figure D.6. *Hypsypops rubicundus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

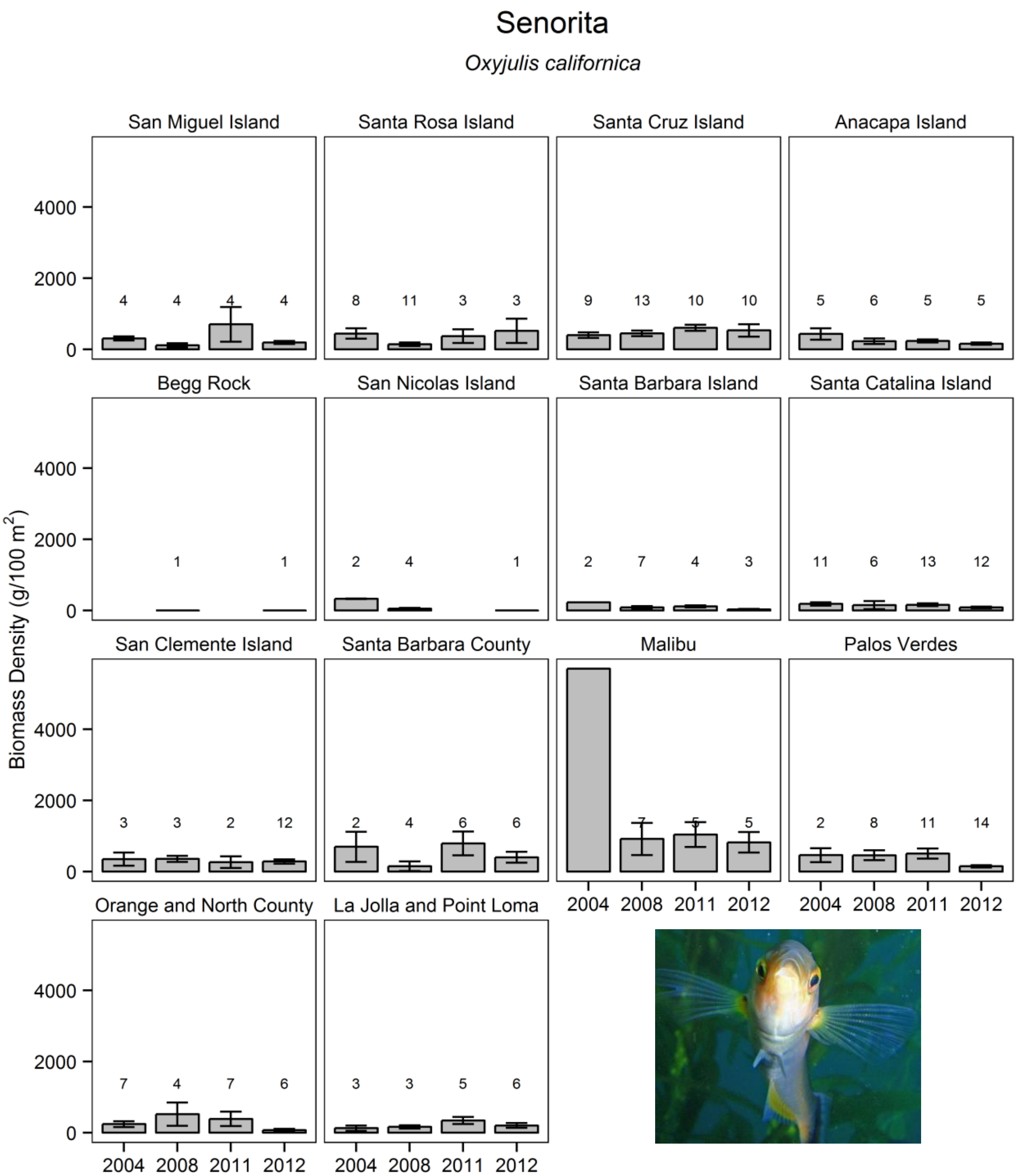


Figure D.7. *Oxyjulis californica* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

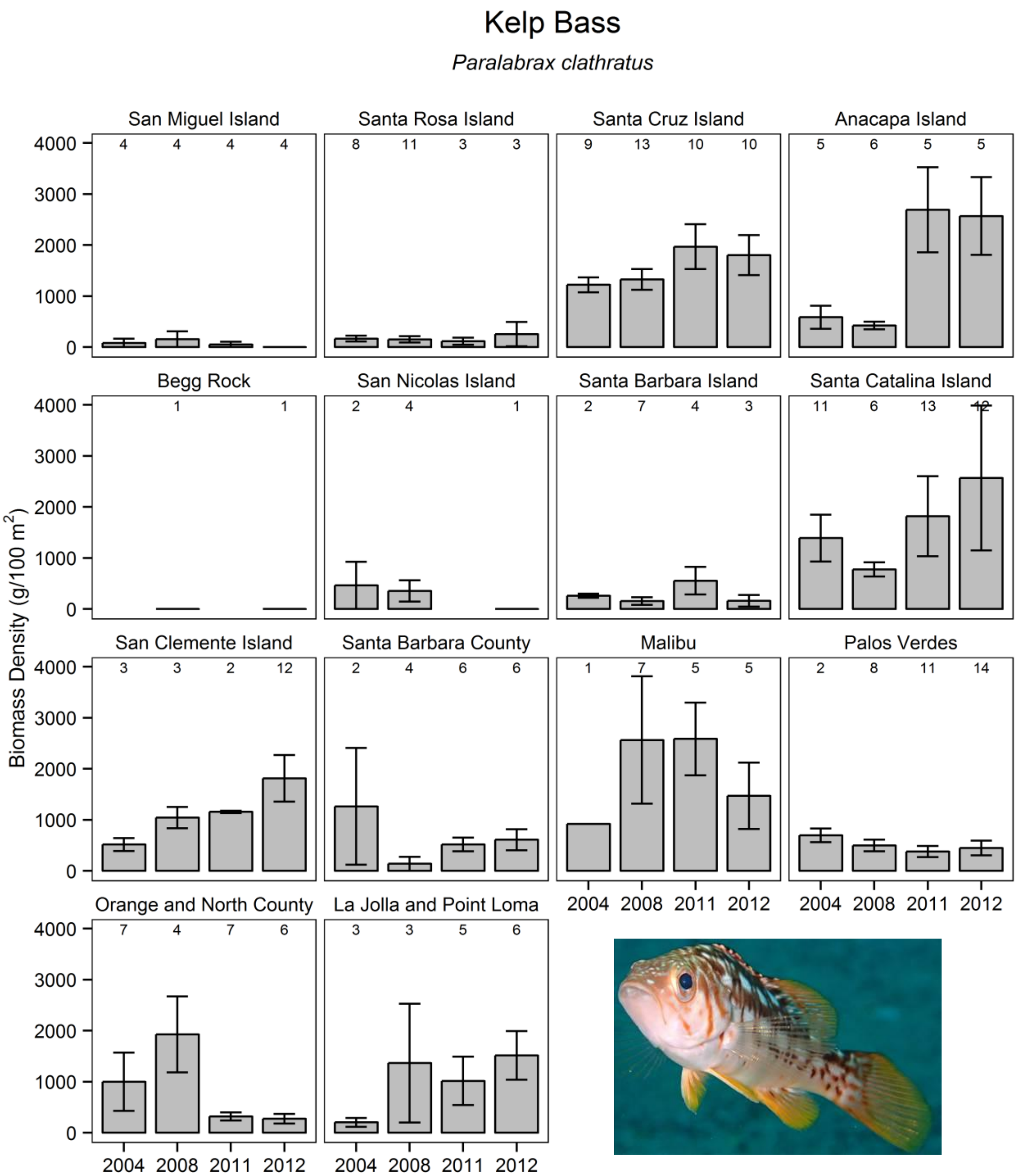


Figure D.8. *Paralabrax clathratus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

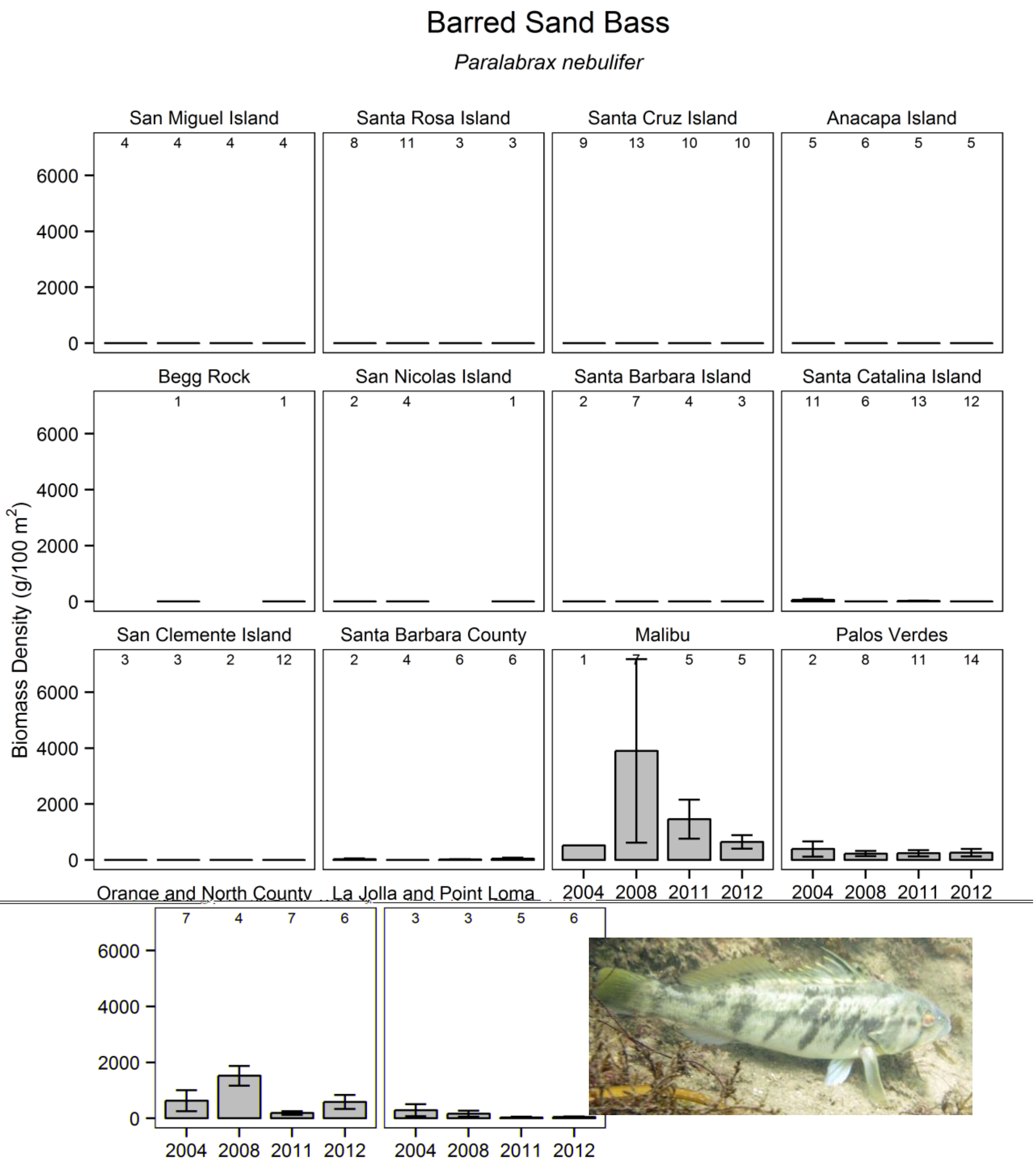


Figure D.9. *Paralabrax nebulifer* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

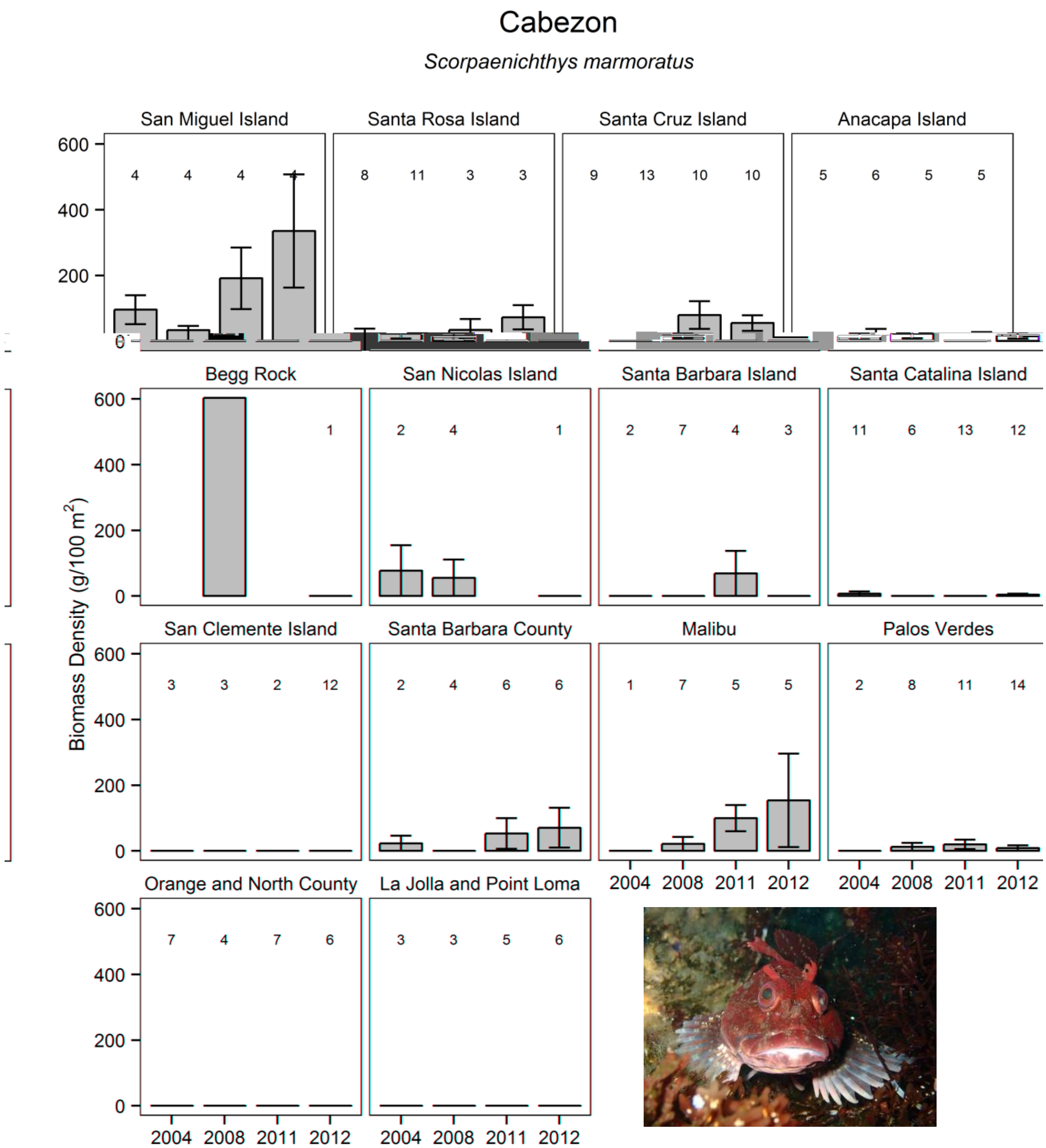


Figure D.10. *Scorpaenichthys marmoratus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

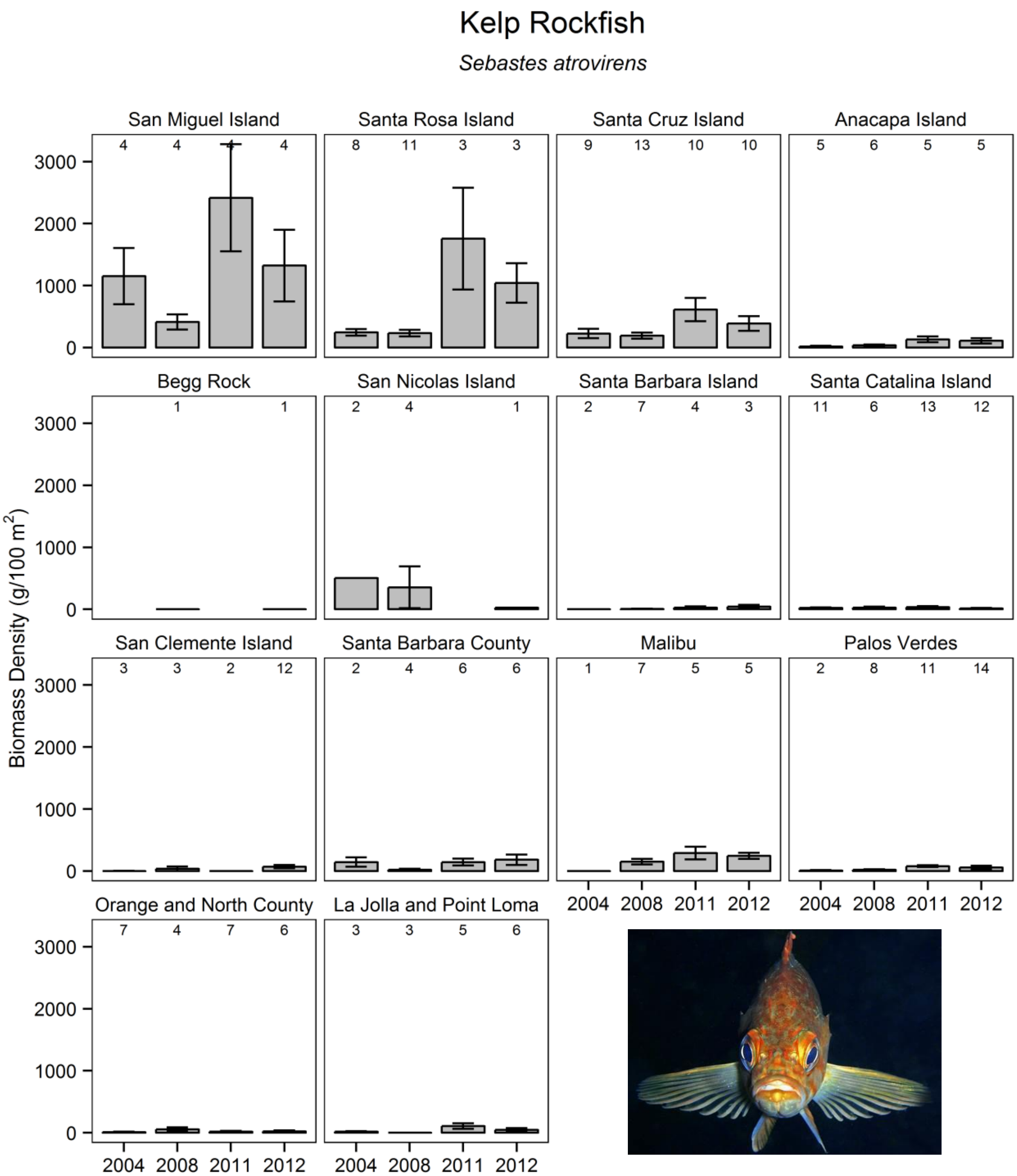


Figure D.11. *Sebastes atrovirens* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

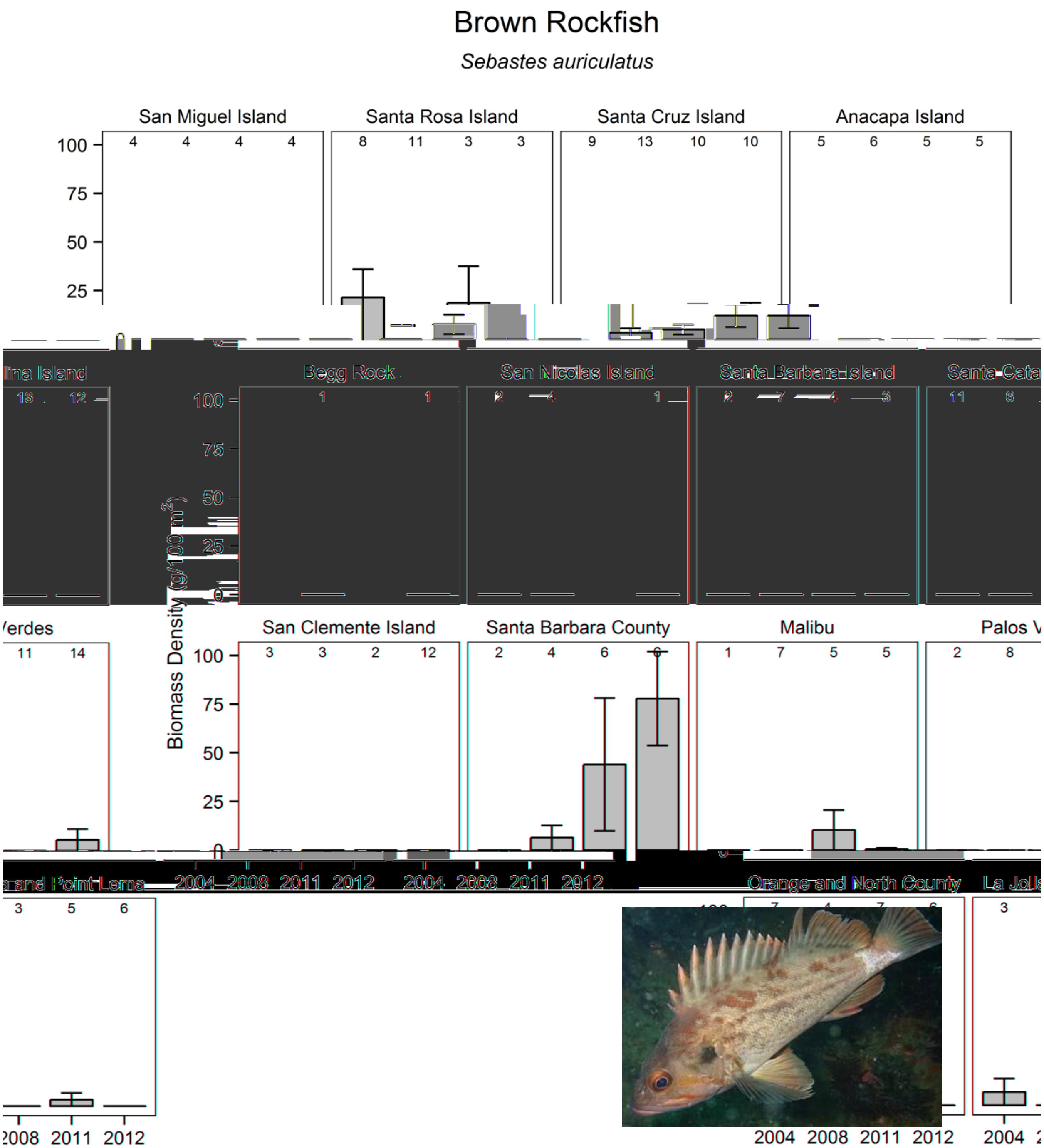


Figure D.12. *Sebastes auriculatus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

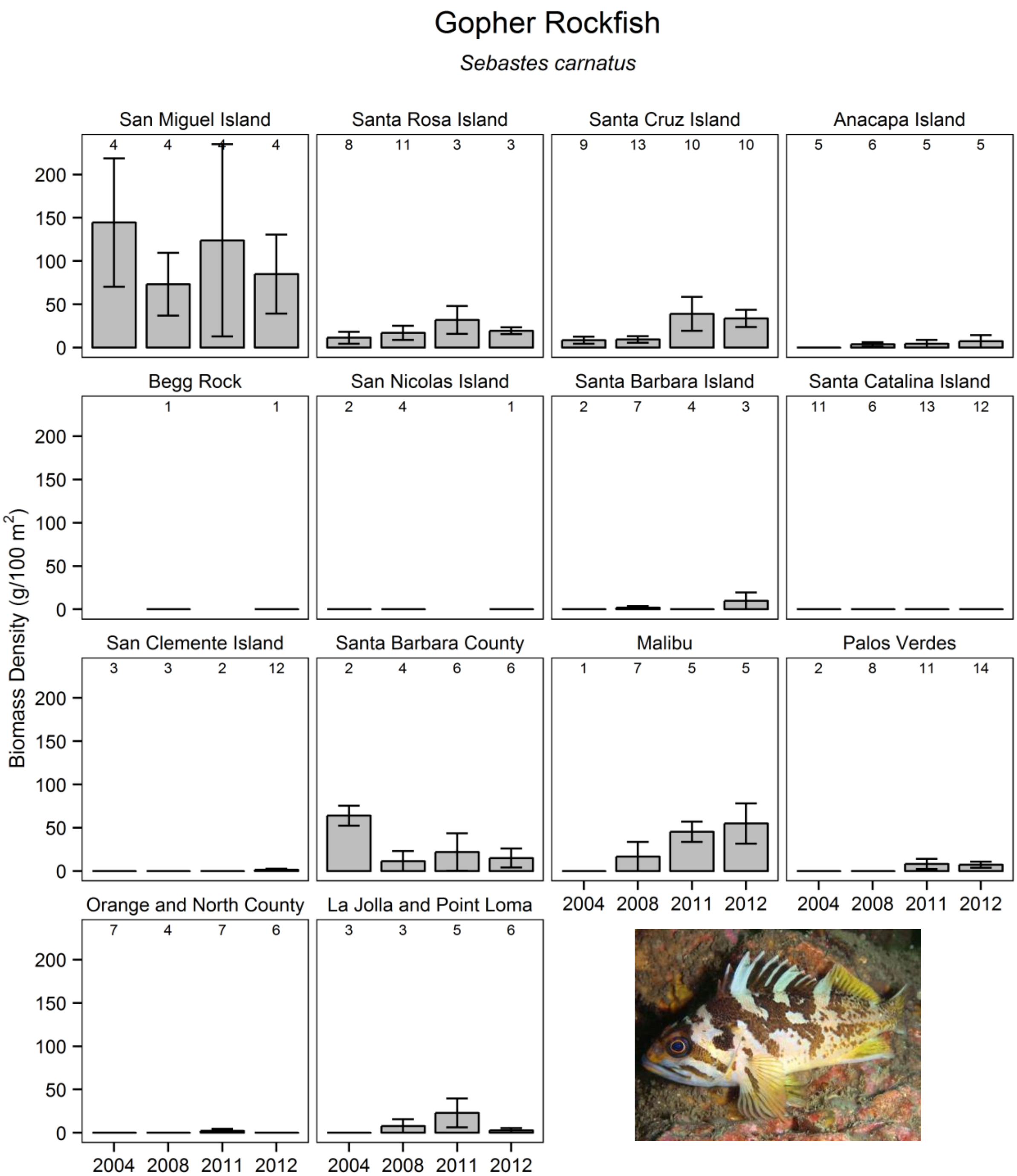


Figure D.13. *Sebastes carnatus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

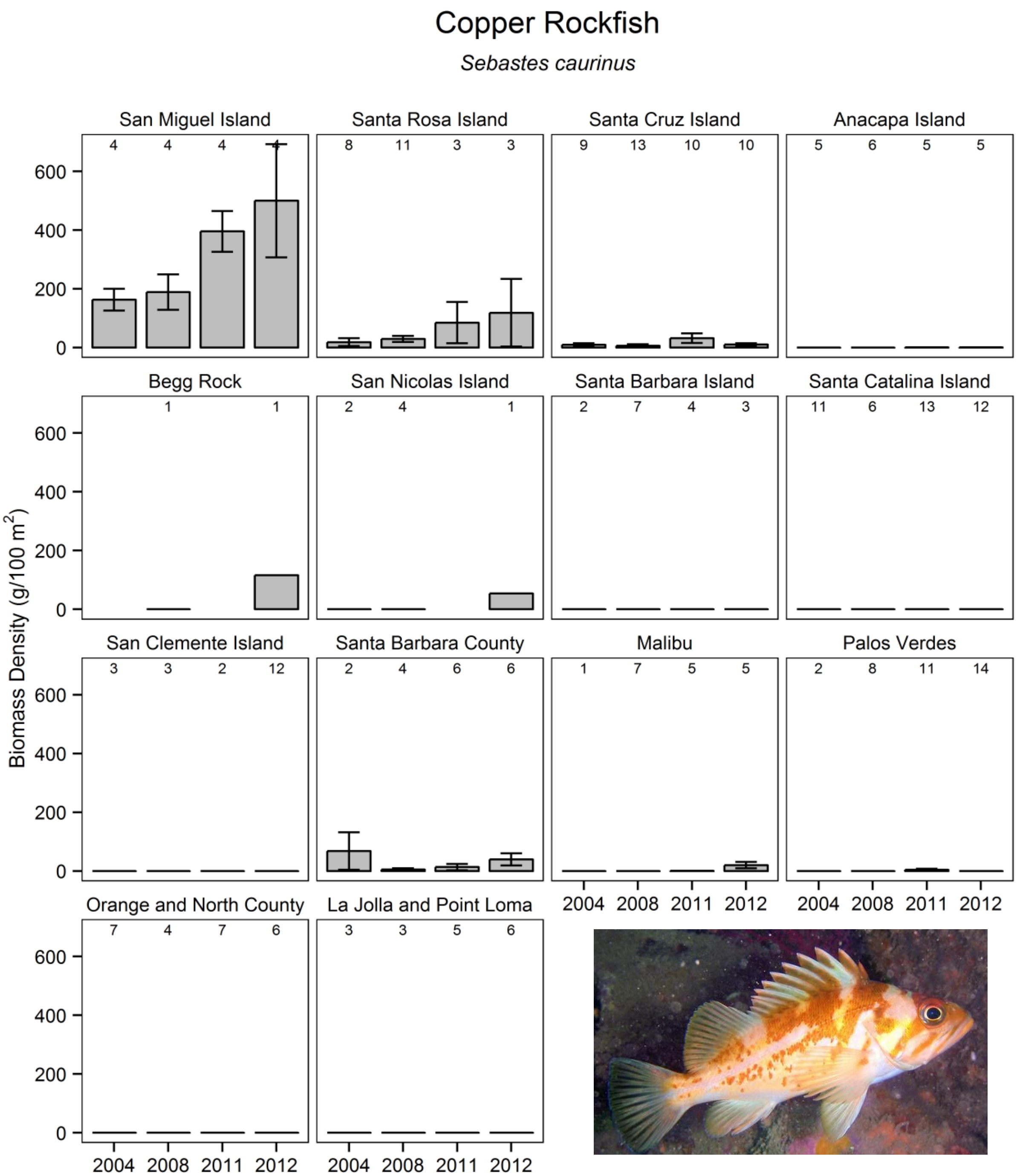


Figure D.14. *Sebastes caurinus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

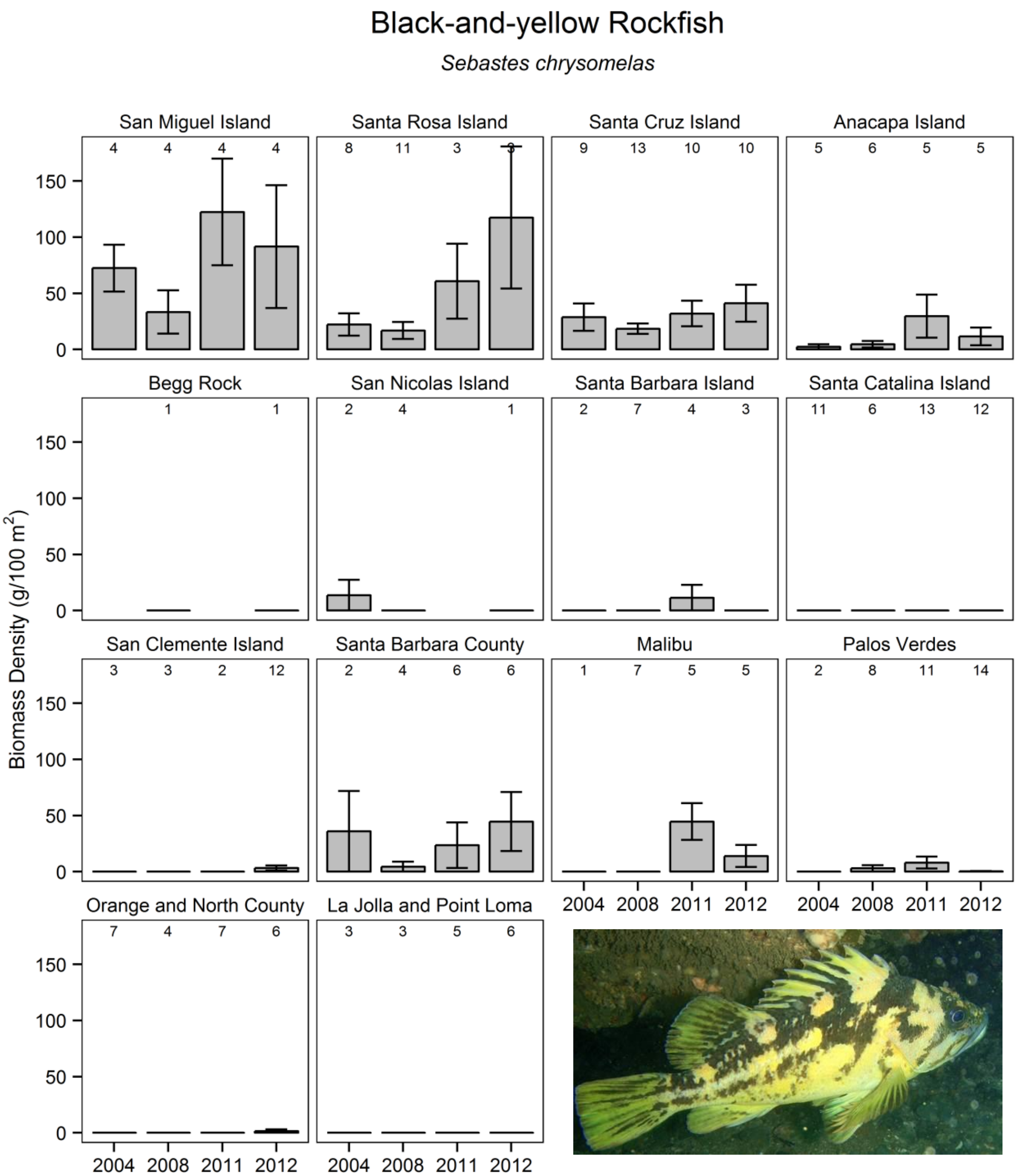


Figure D.15. *Sebastes chrysomelas* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

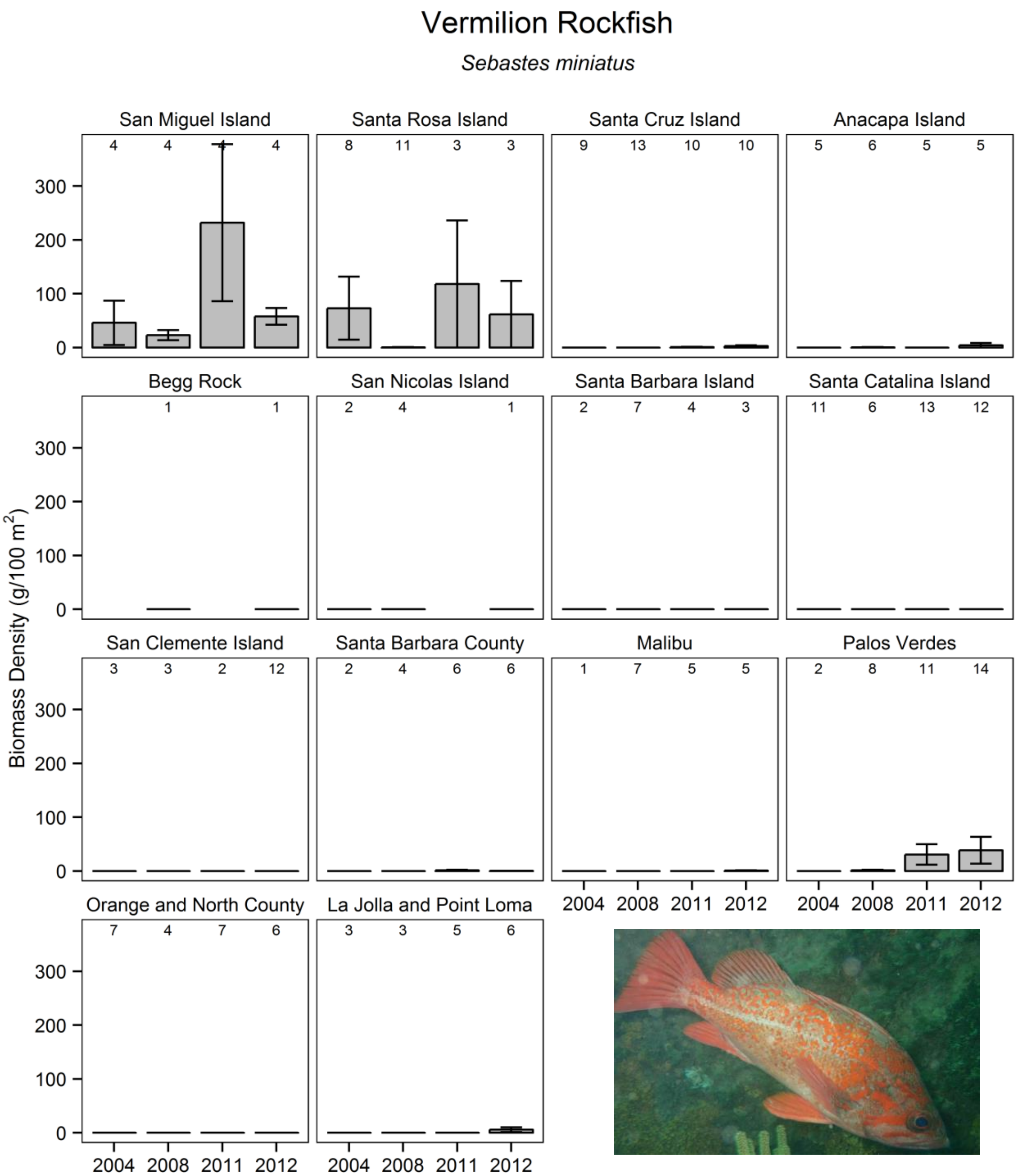


Figure D.16. *Sebastes miniatus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

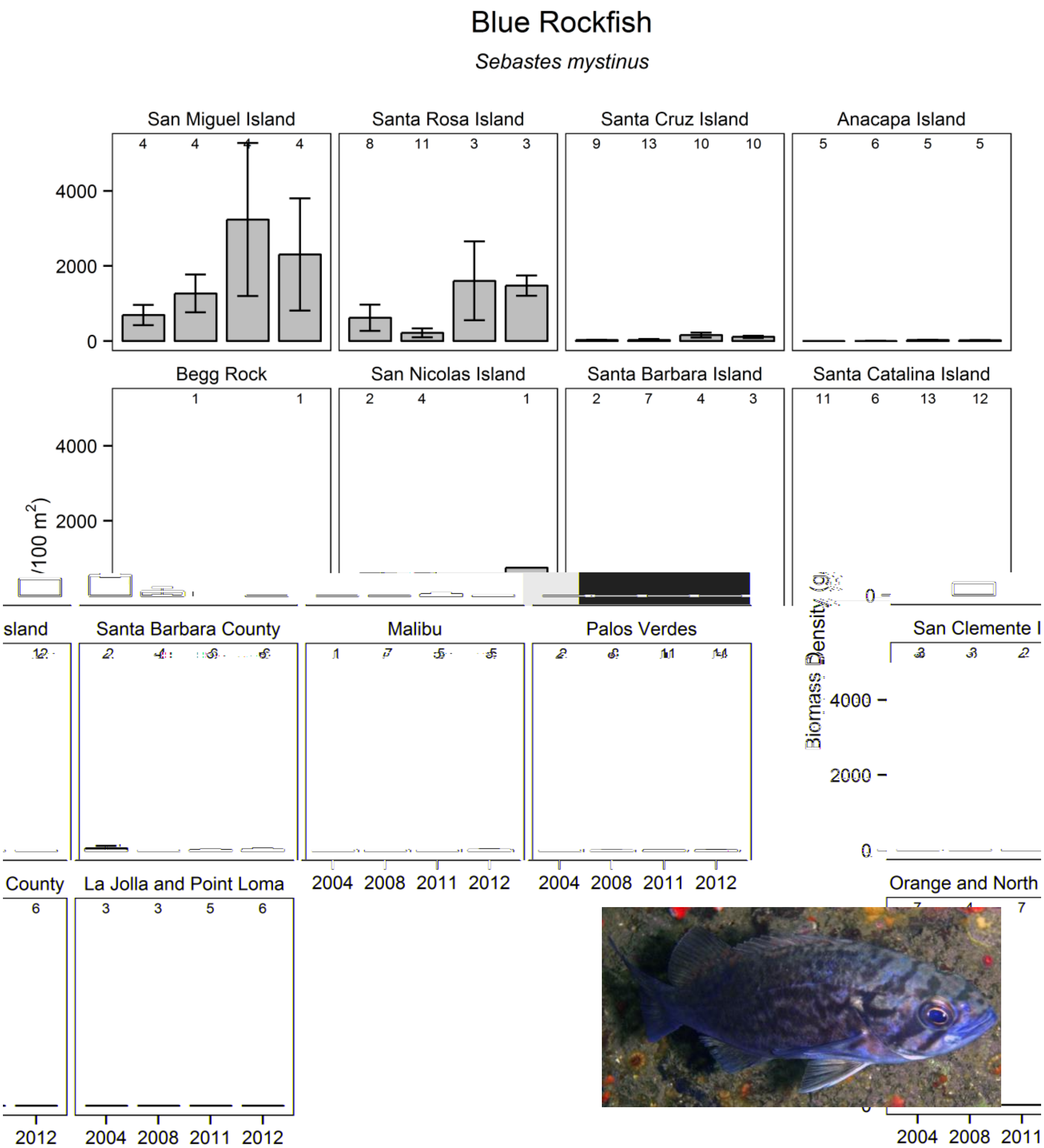


Figure D.17. *Sebastes mystinus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

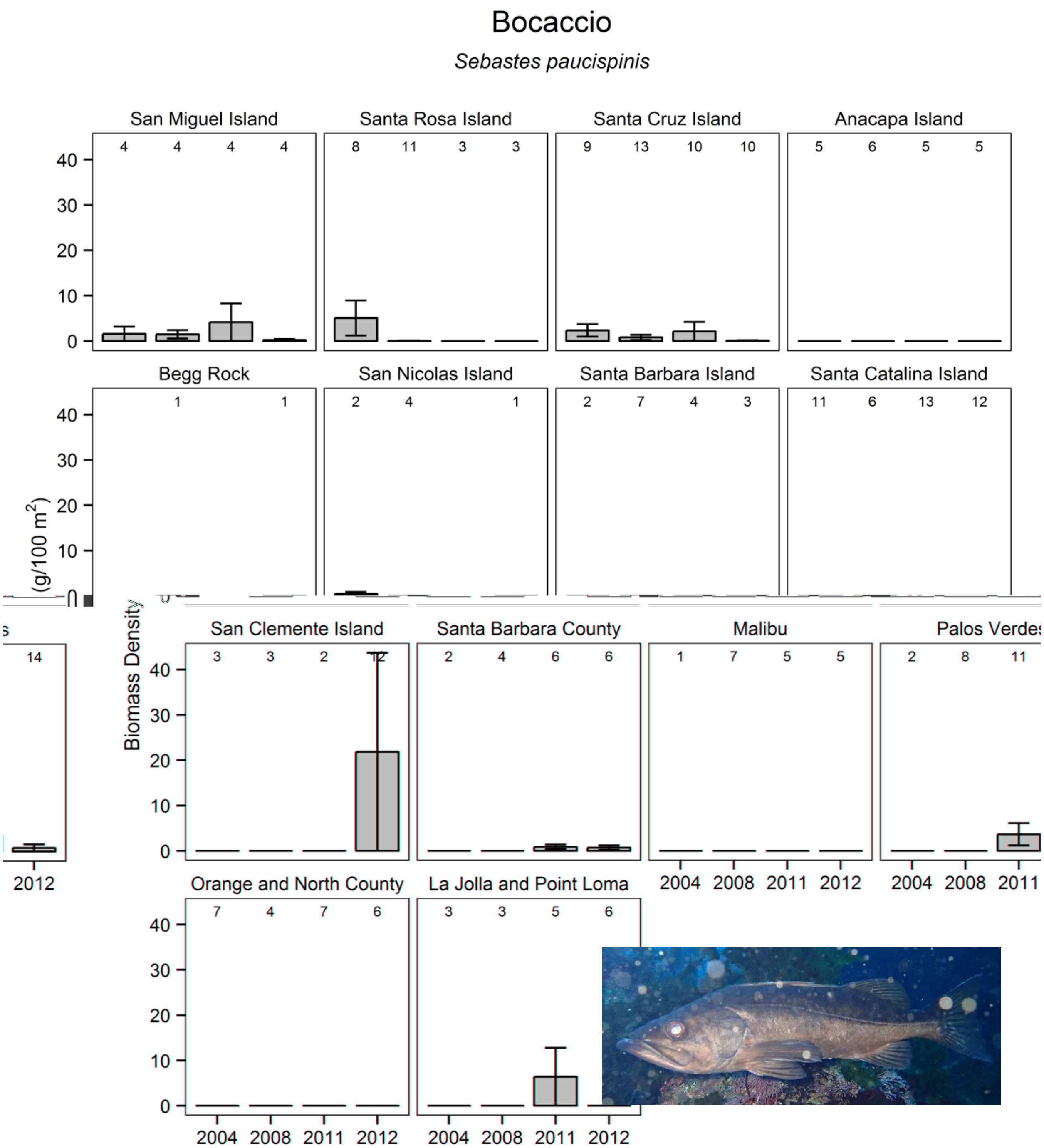


Figure D.18. *Sebastes paucispinis* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

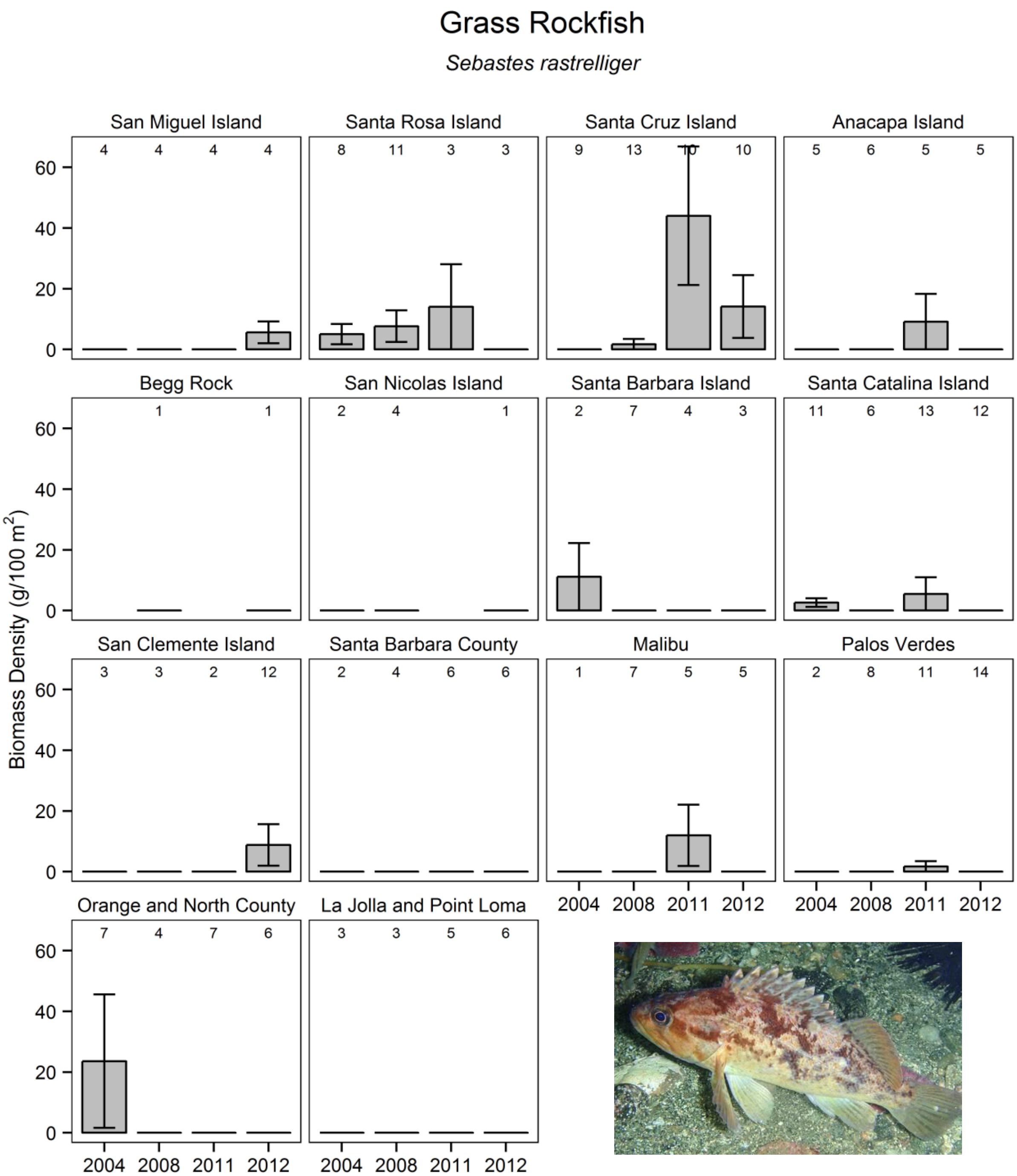


Figure D.19. *Sebastes rastrelliger* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

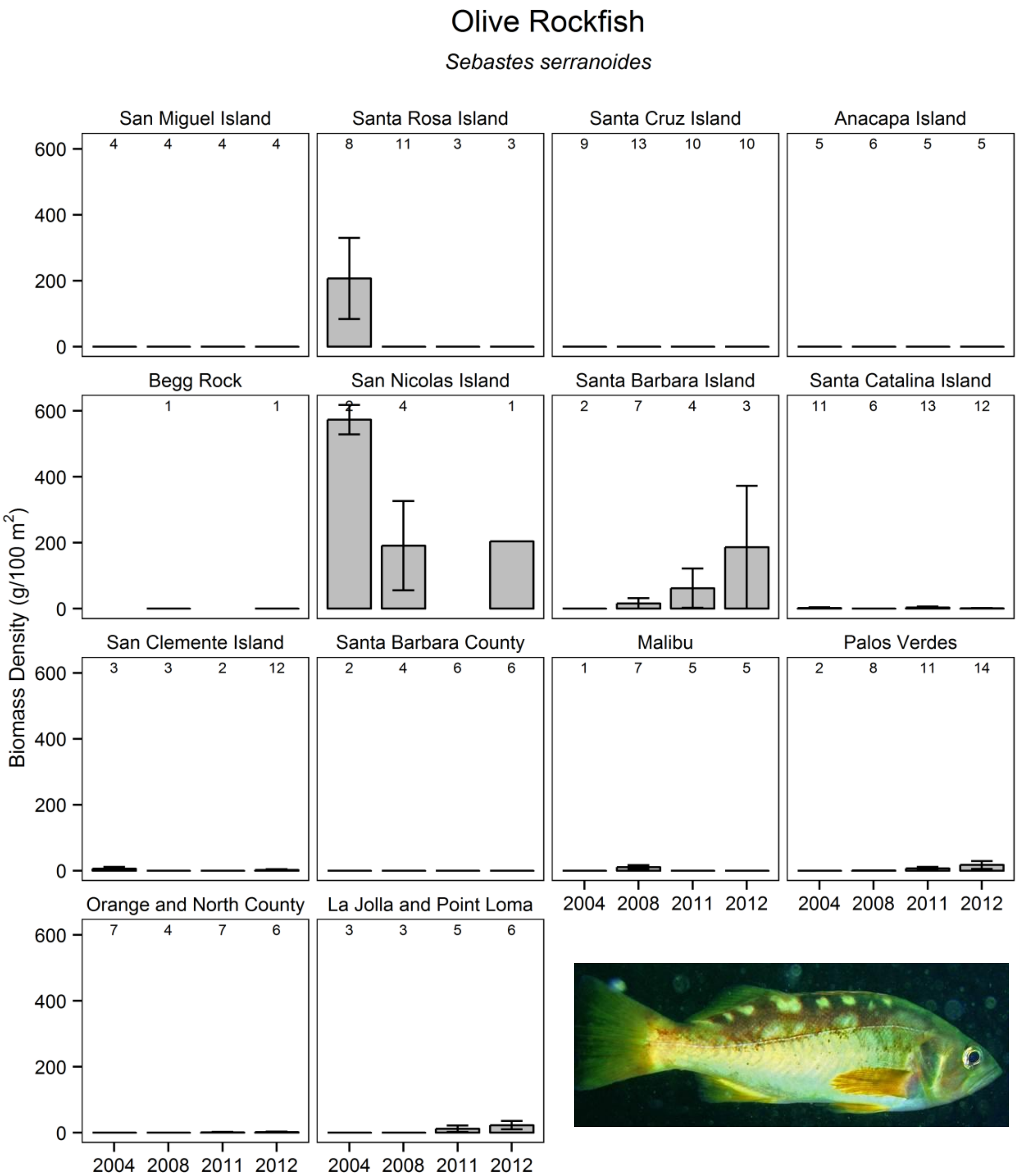


Figure D.20. *Sebastes serranoides* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

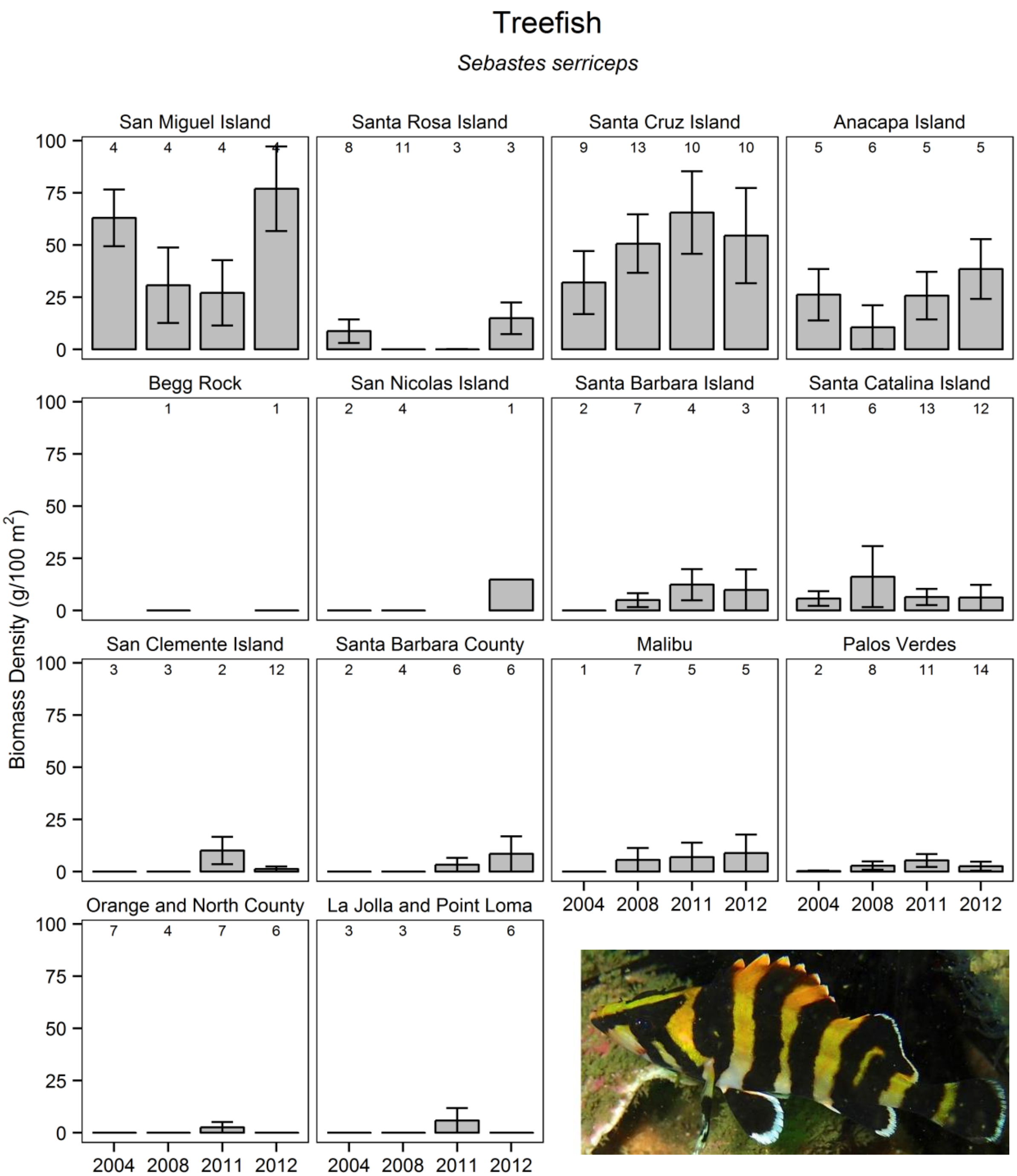


Figure D.21. *Sebastes serriceps* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

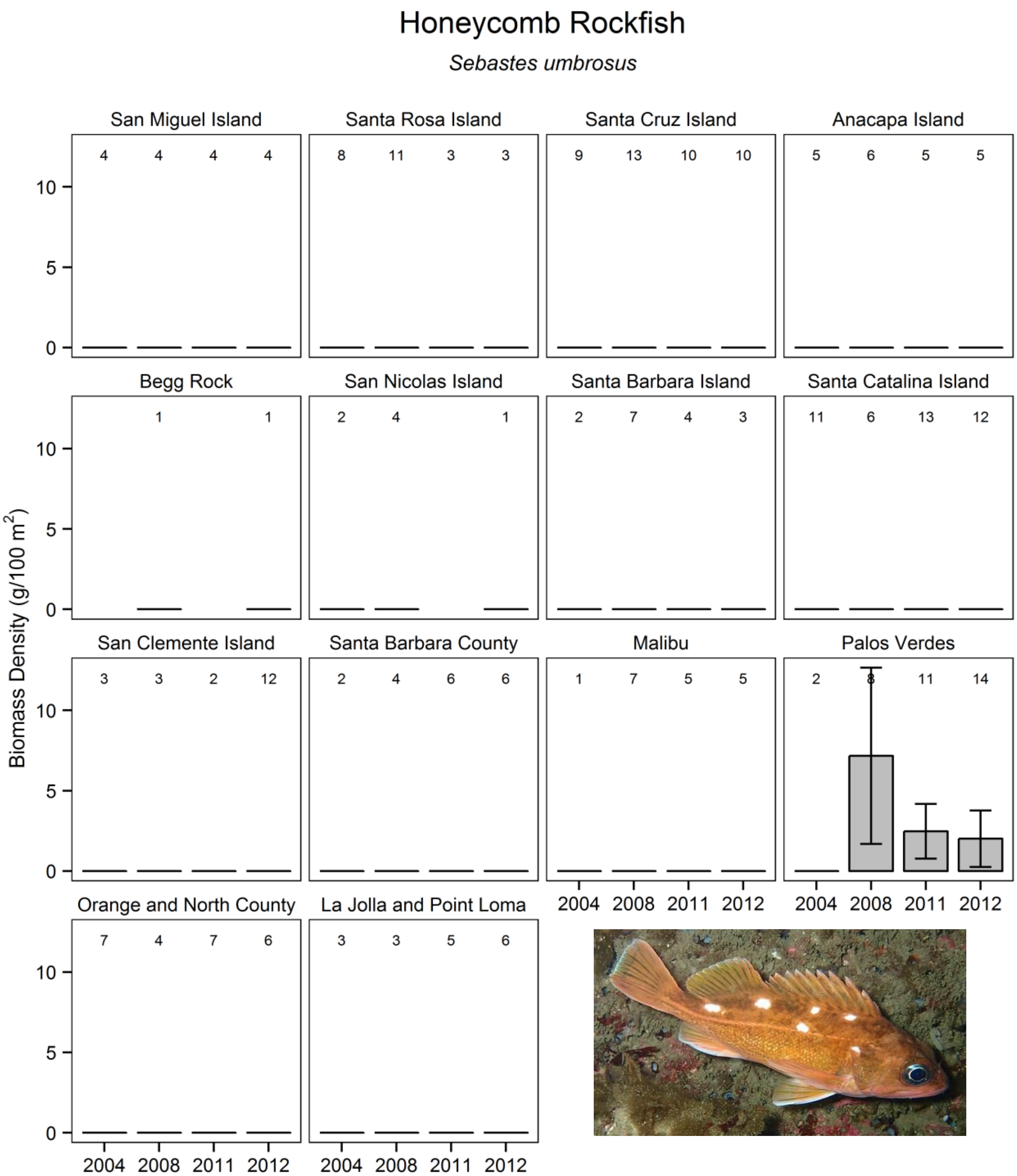


Figure D.22. *Sebastes umbrosus* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

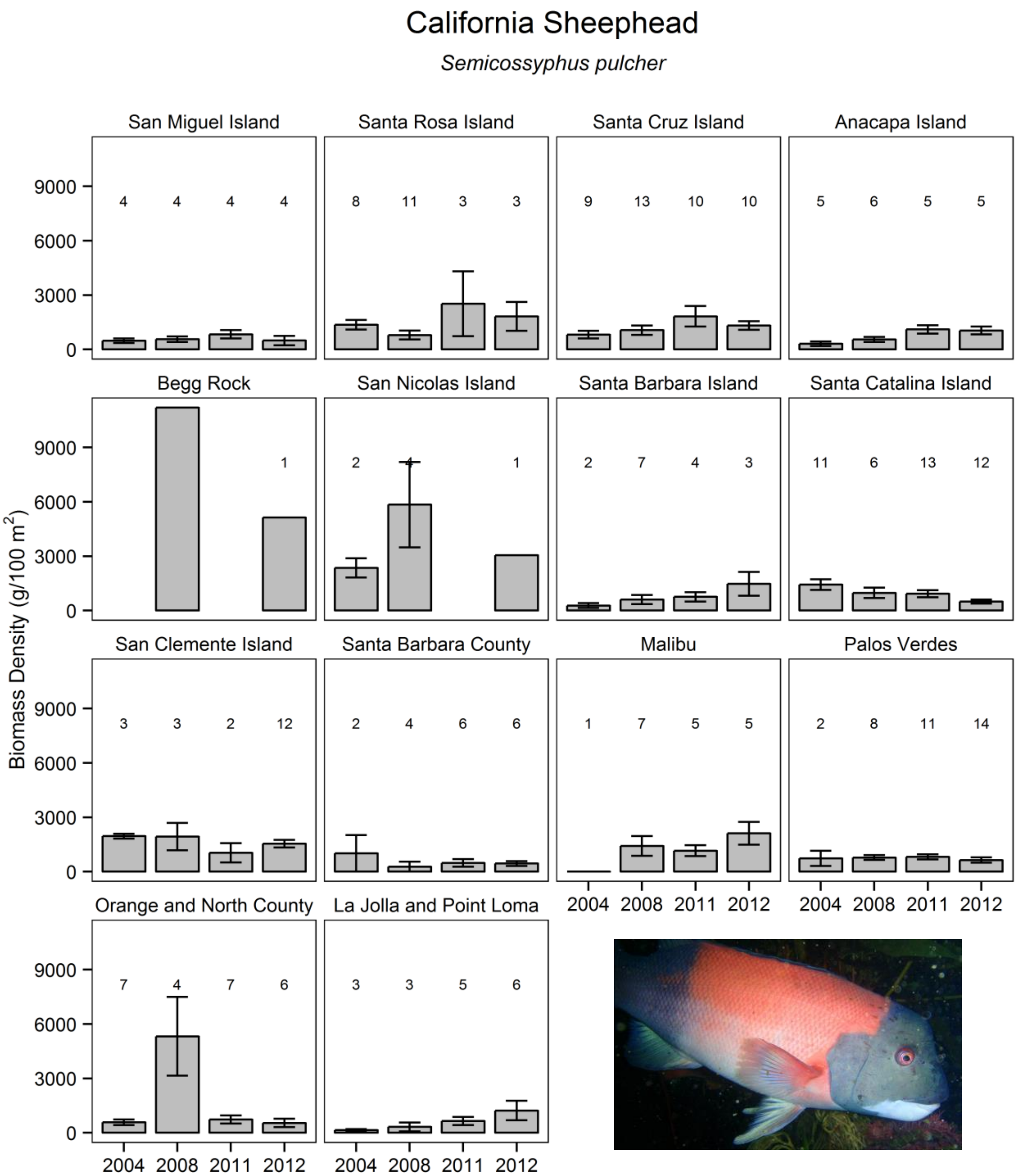


Figure D.23. *Semicossyphus pulcher* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

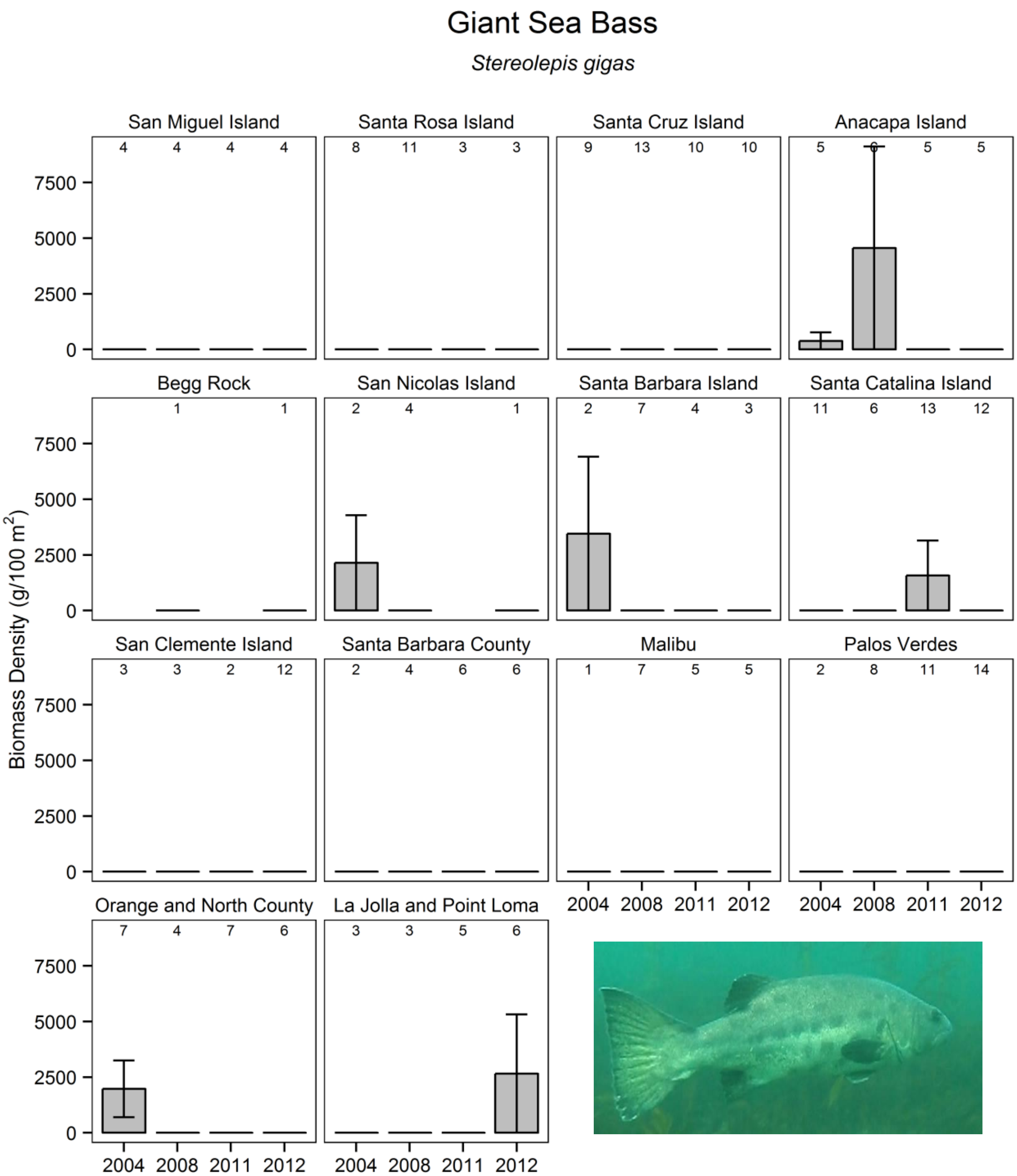


Figure D.24. *Stereolepis gigas* biomass density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

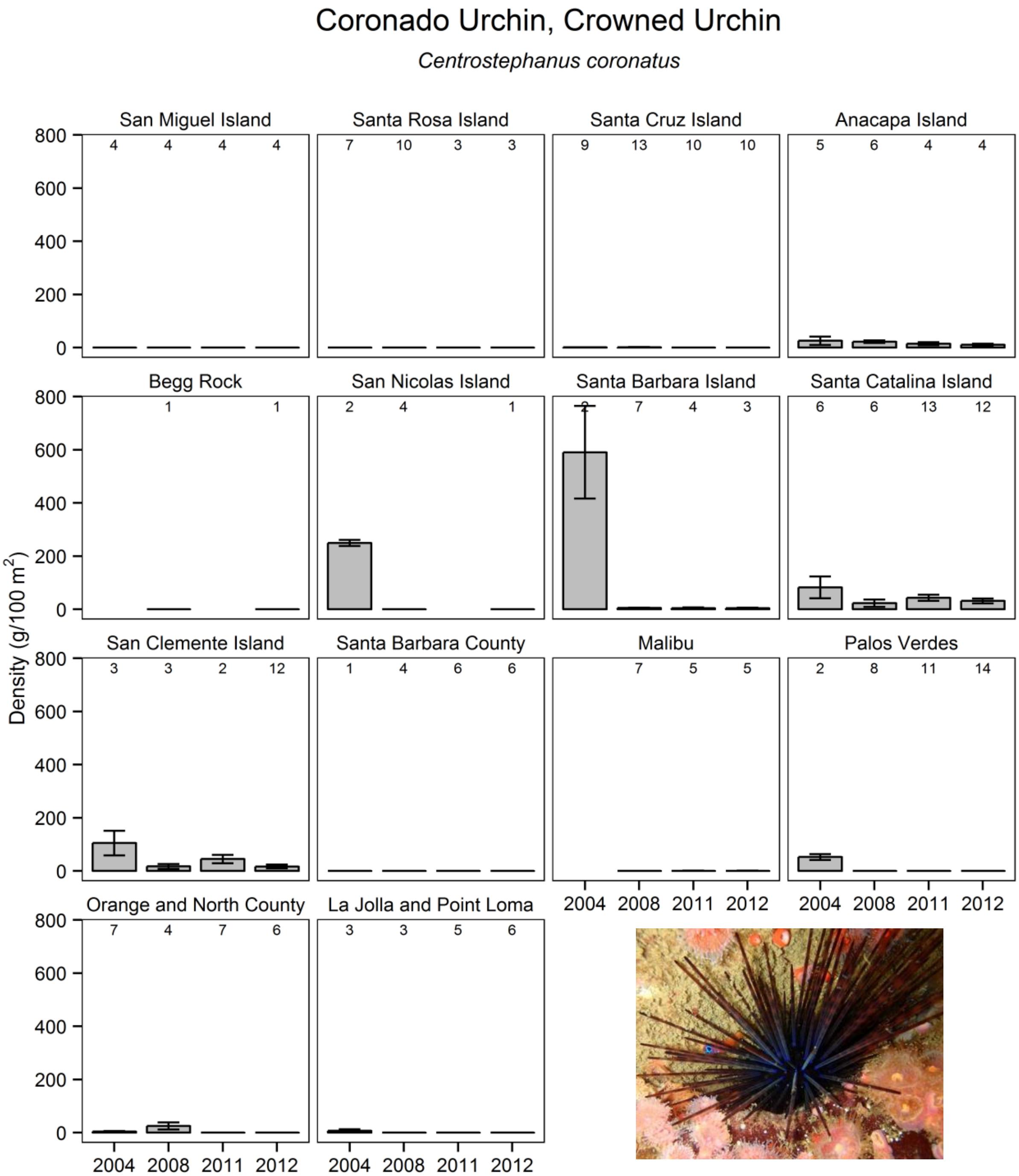


Figure D.25. *Centrostephanus coronatus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

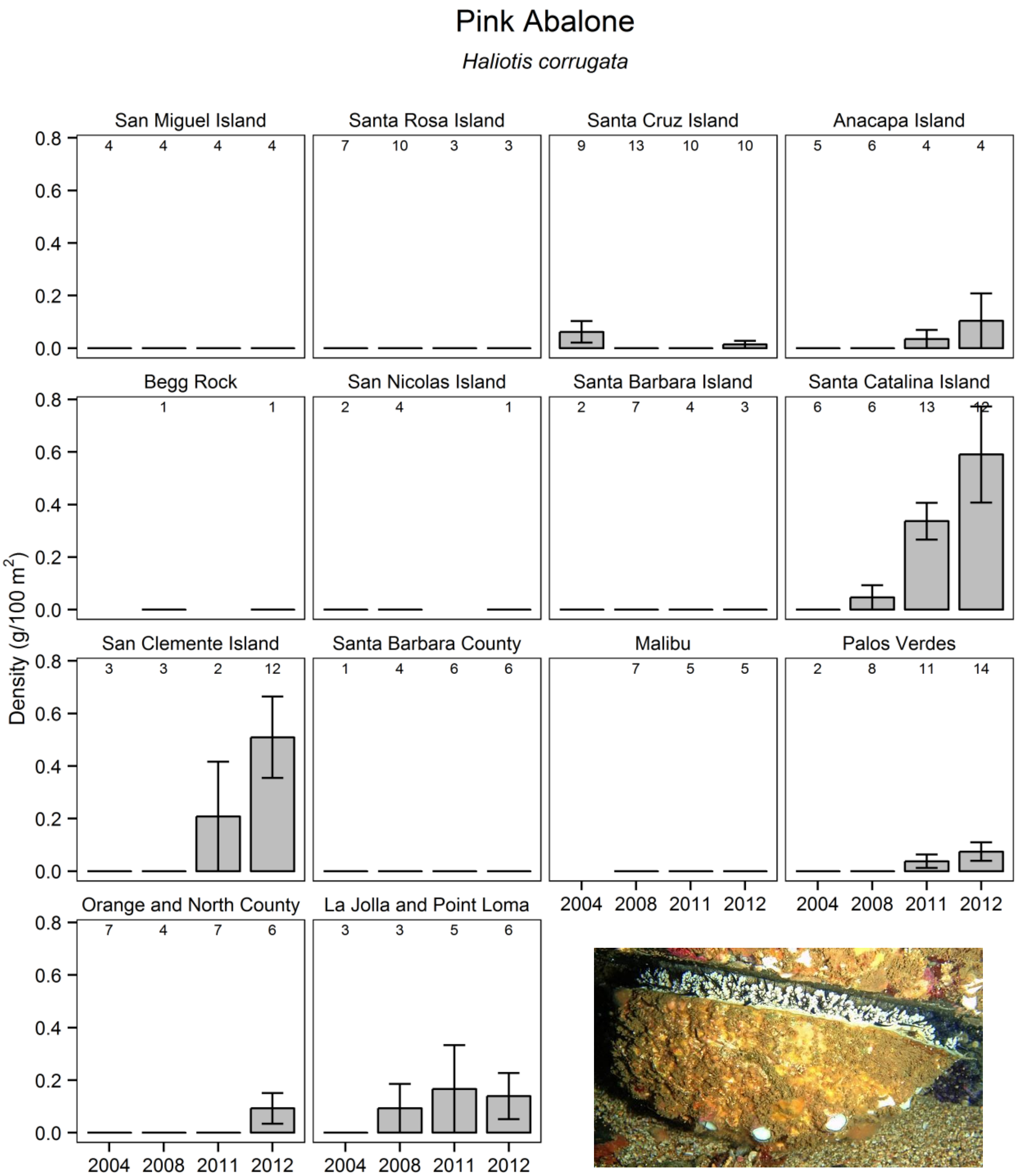


Figure D.26. *Haliotis corrugata* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

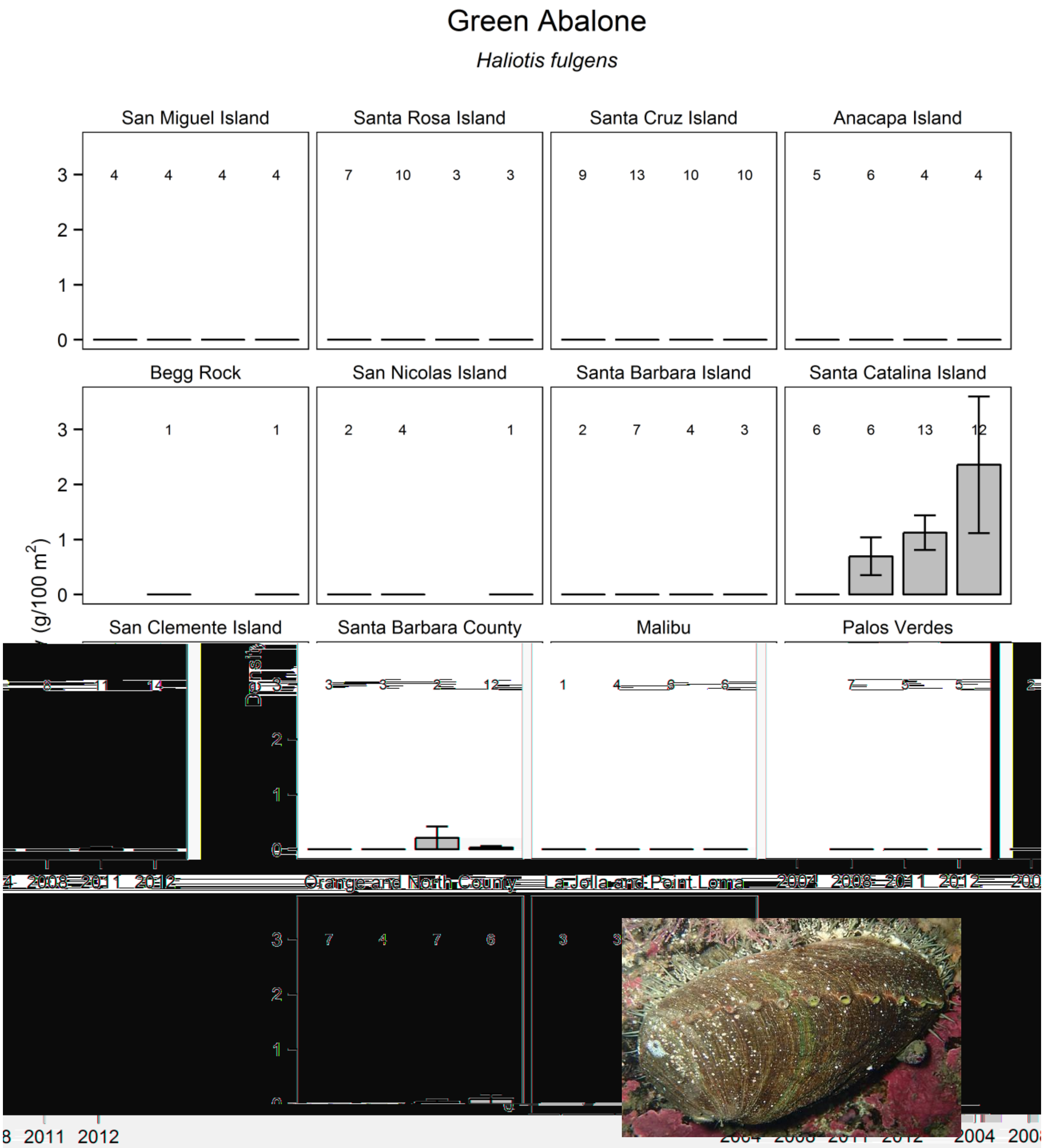


Figure D.27. *Haliotis fulgens* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

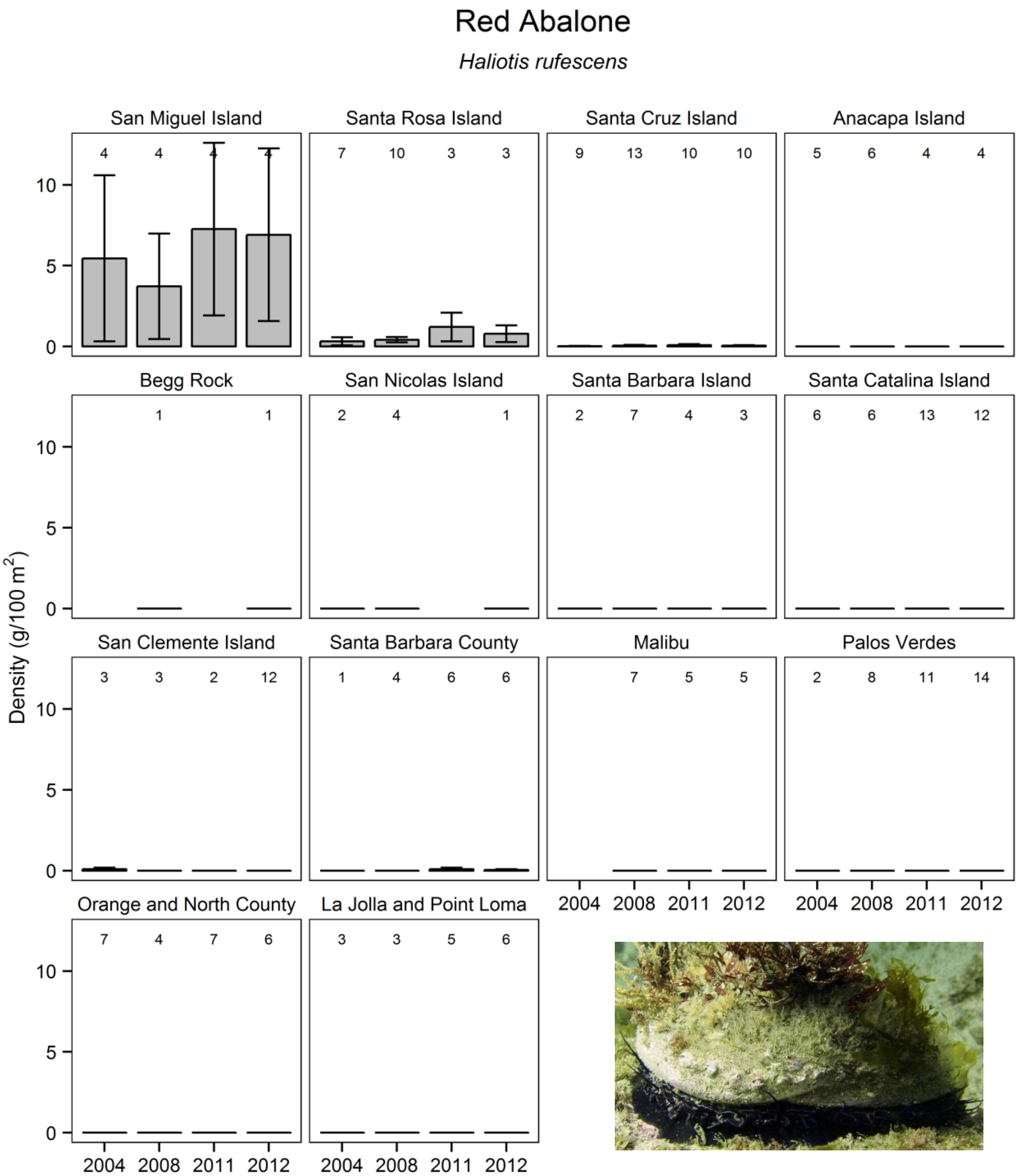


Figure D.28. *Haliotis rufescens* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

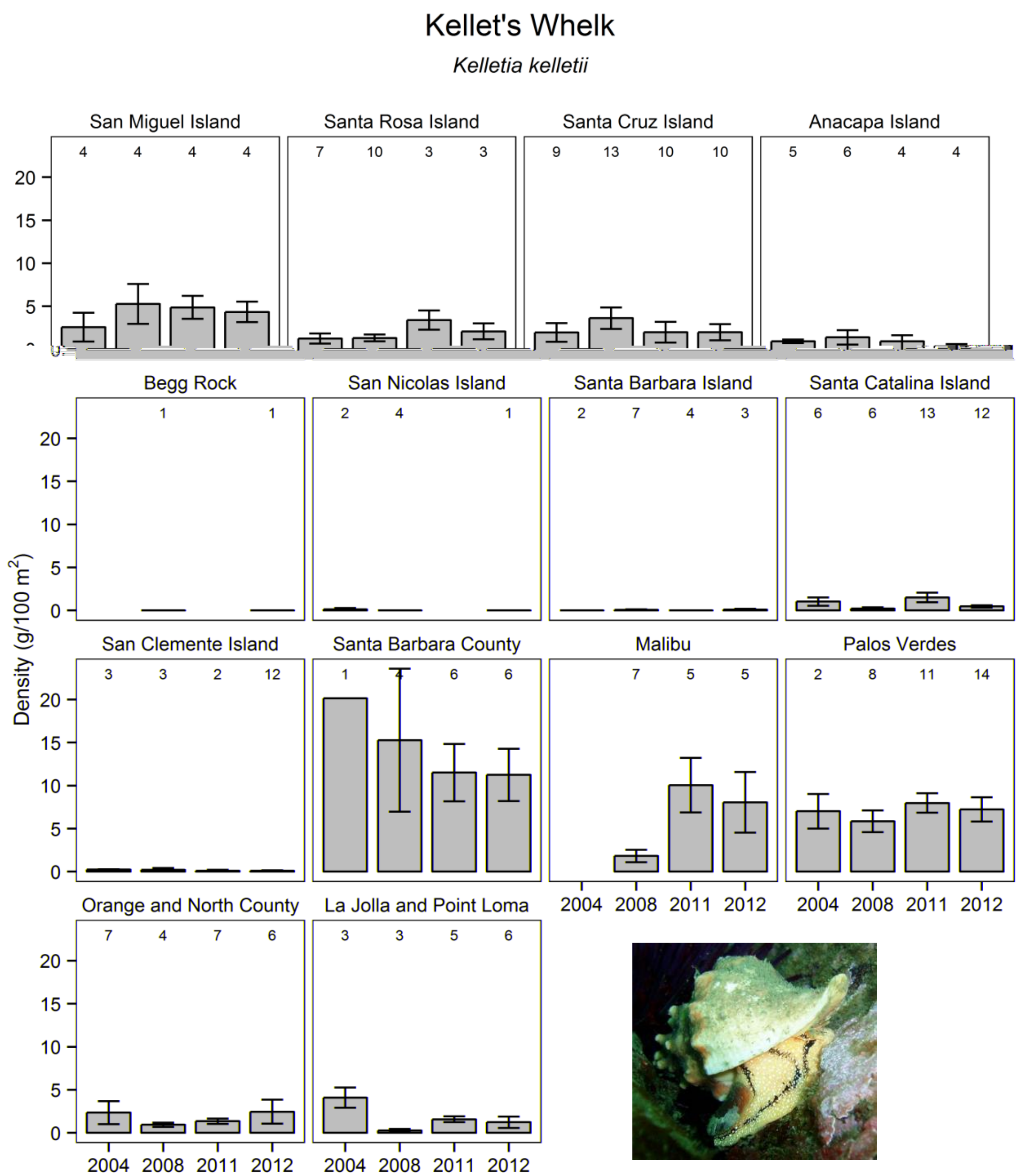


Figure D.29. *Kelletia kelletii* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

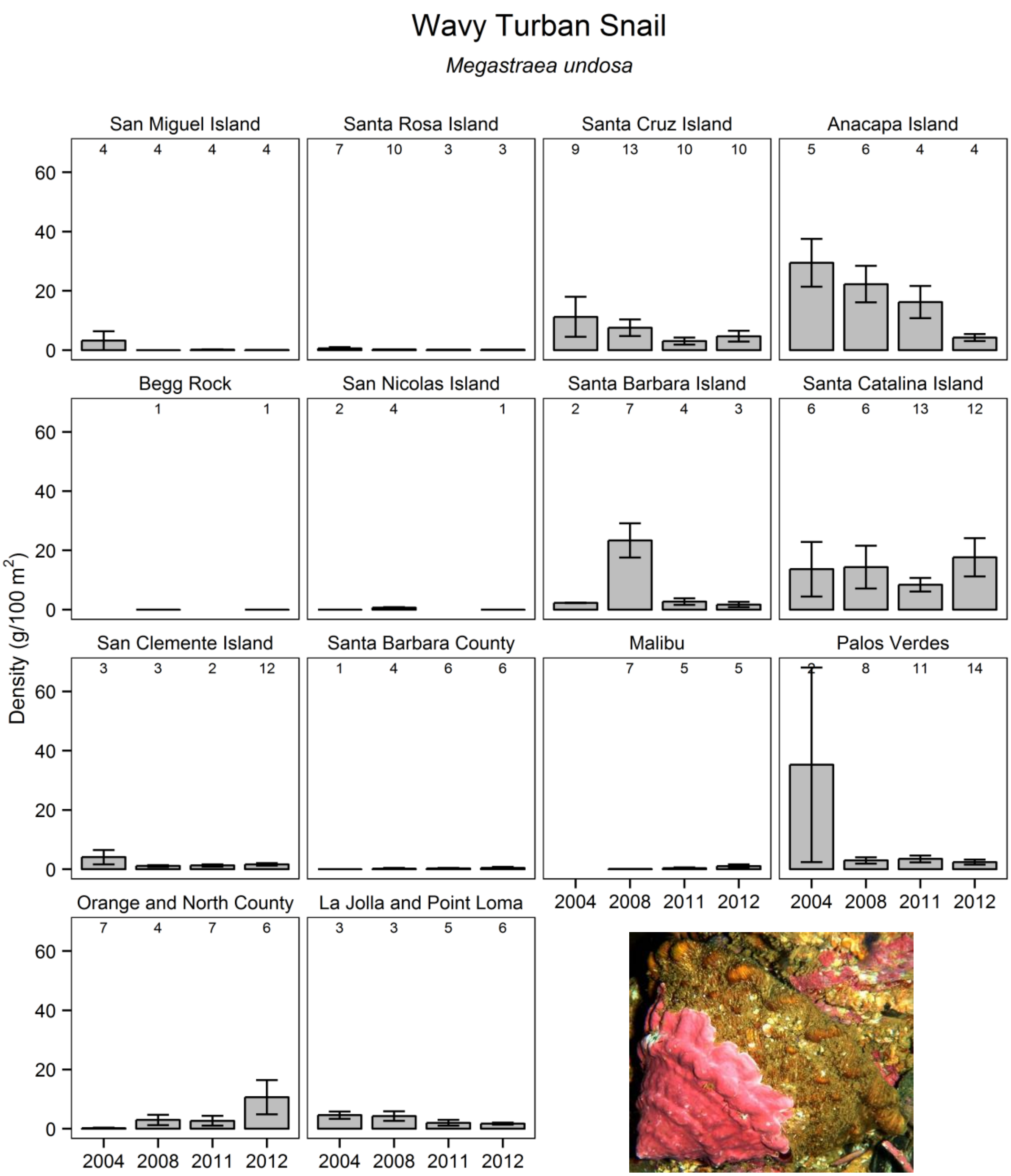


Figure D.30. *Megastraea undosa* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

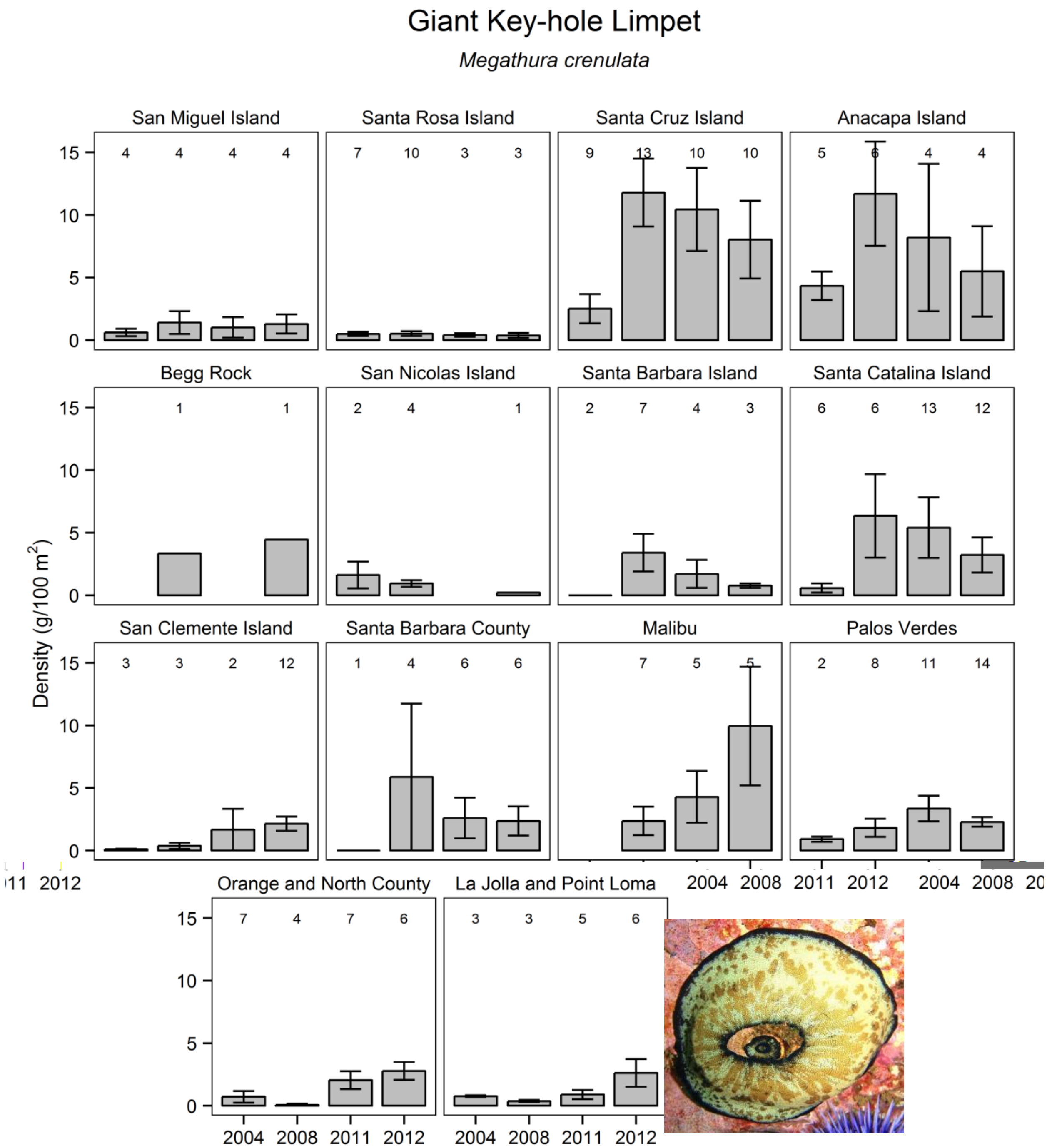


Figure D.31. *Megathura crenulata* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

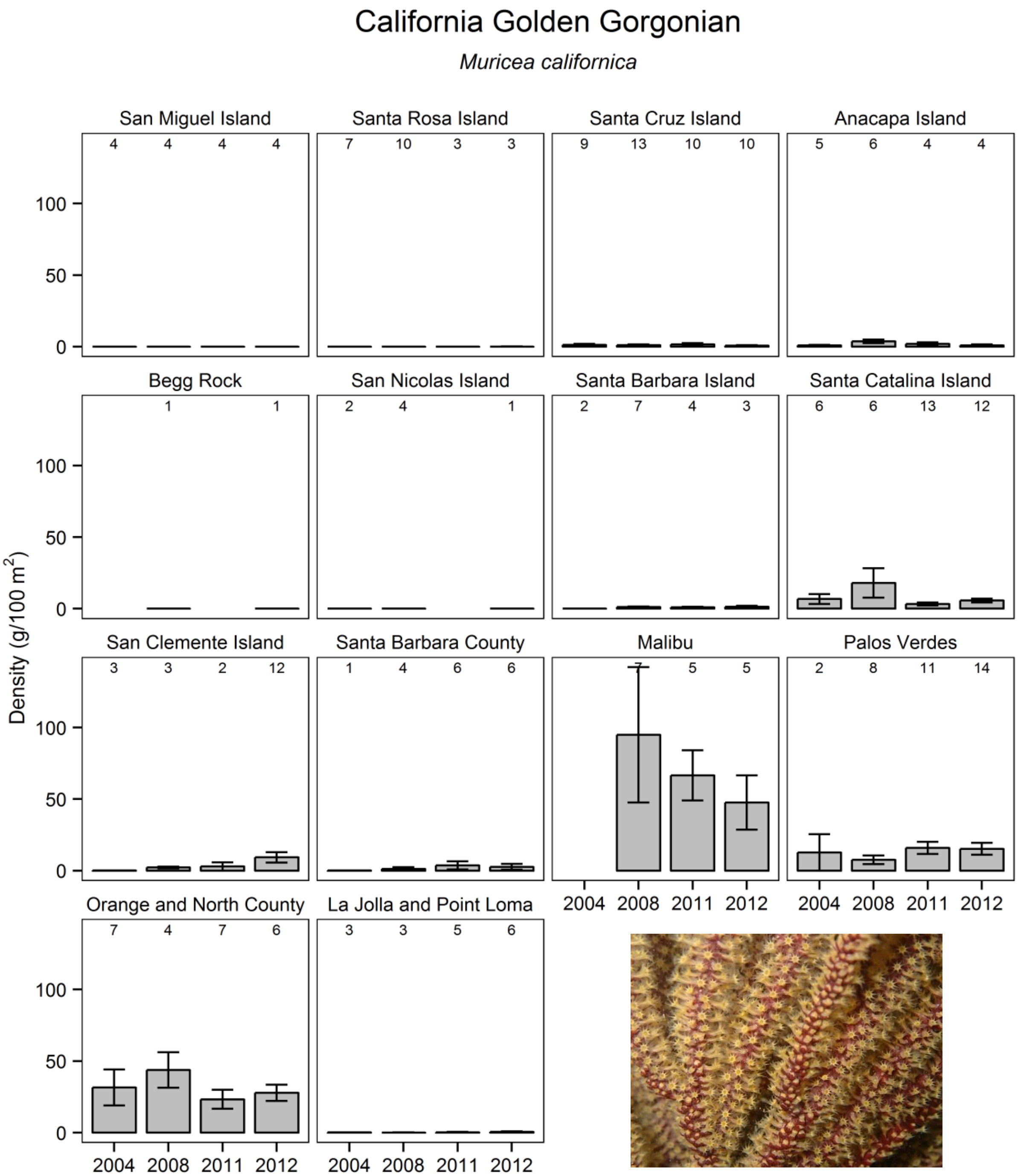


Figure D.32. *Muricea californica* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

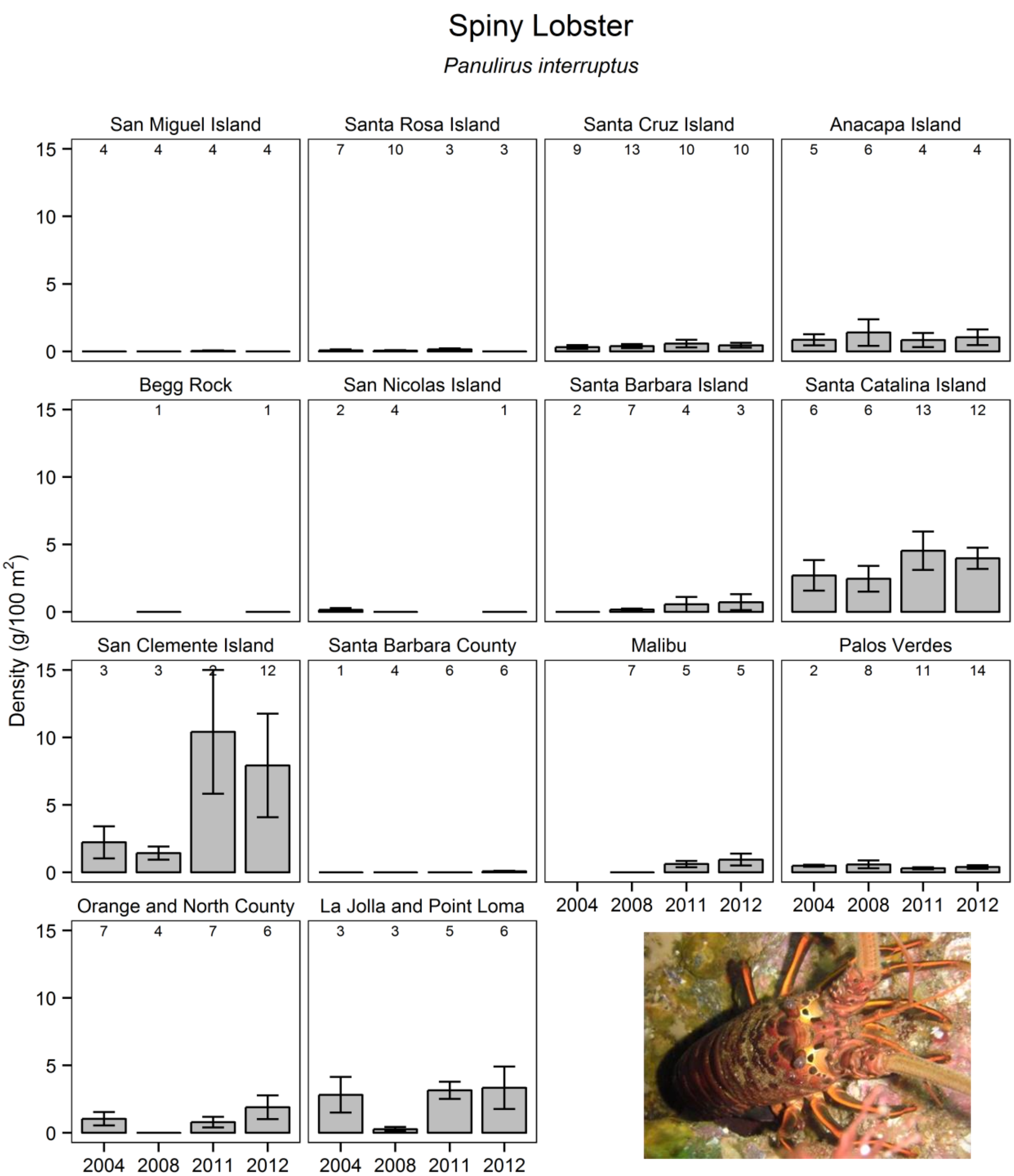


Figure D.33. *Panulirus interruptus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

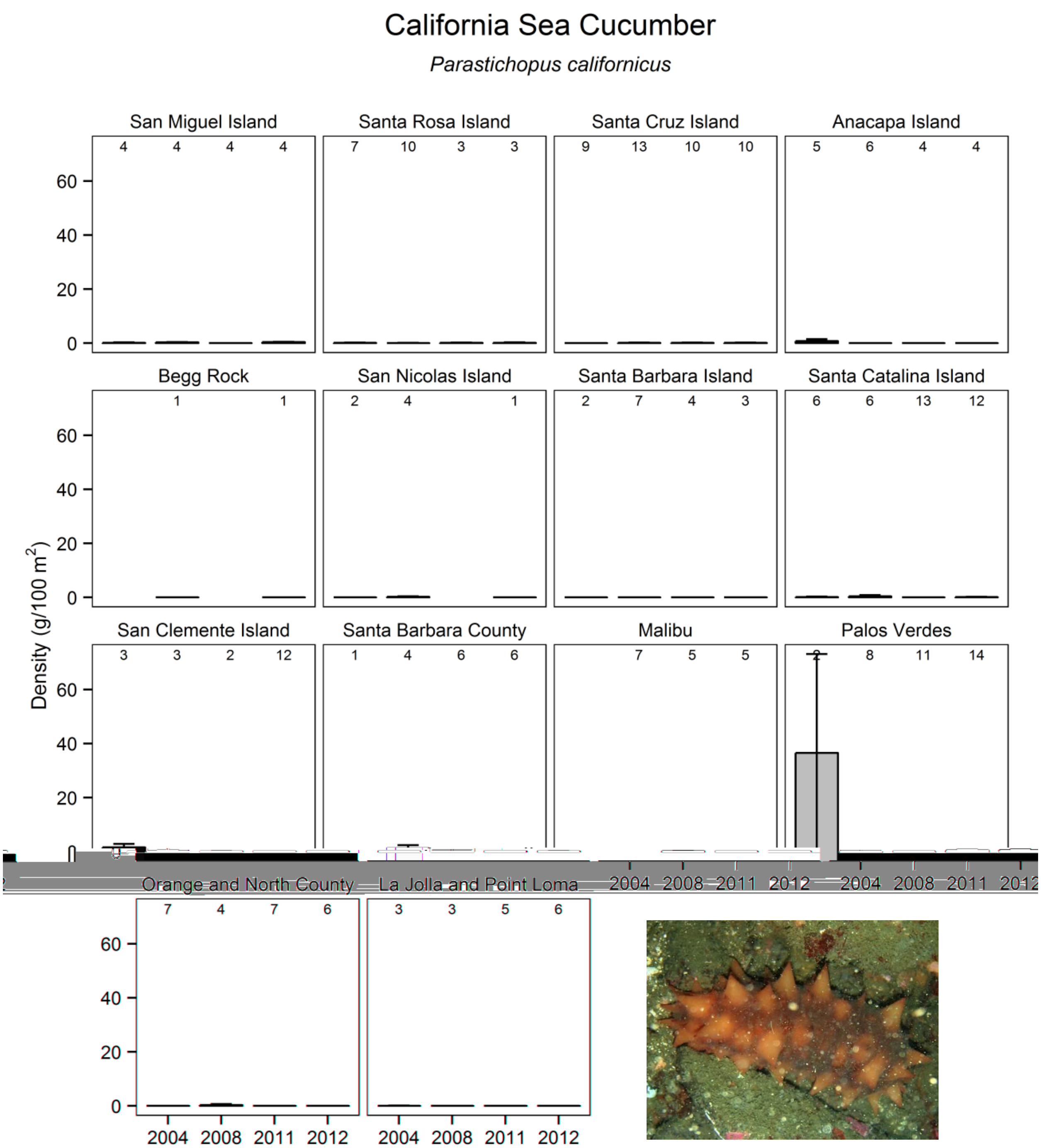


Figure D.34. *Parastichopus californicus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

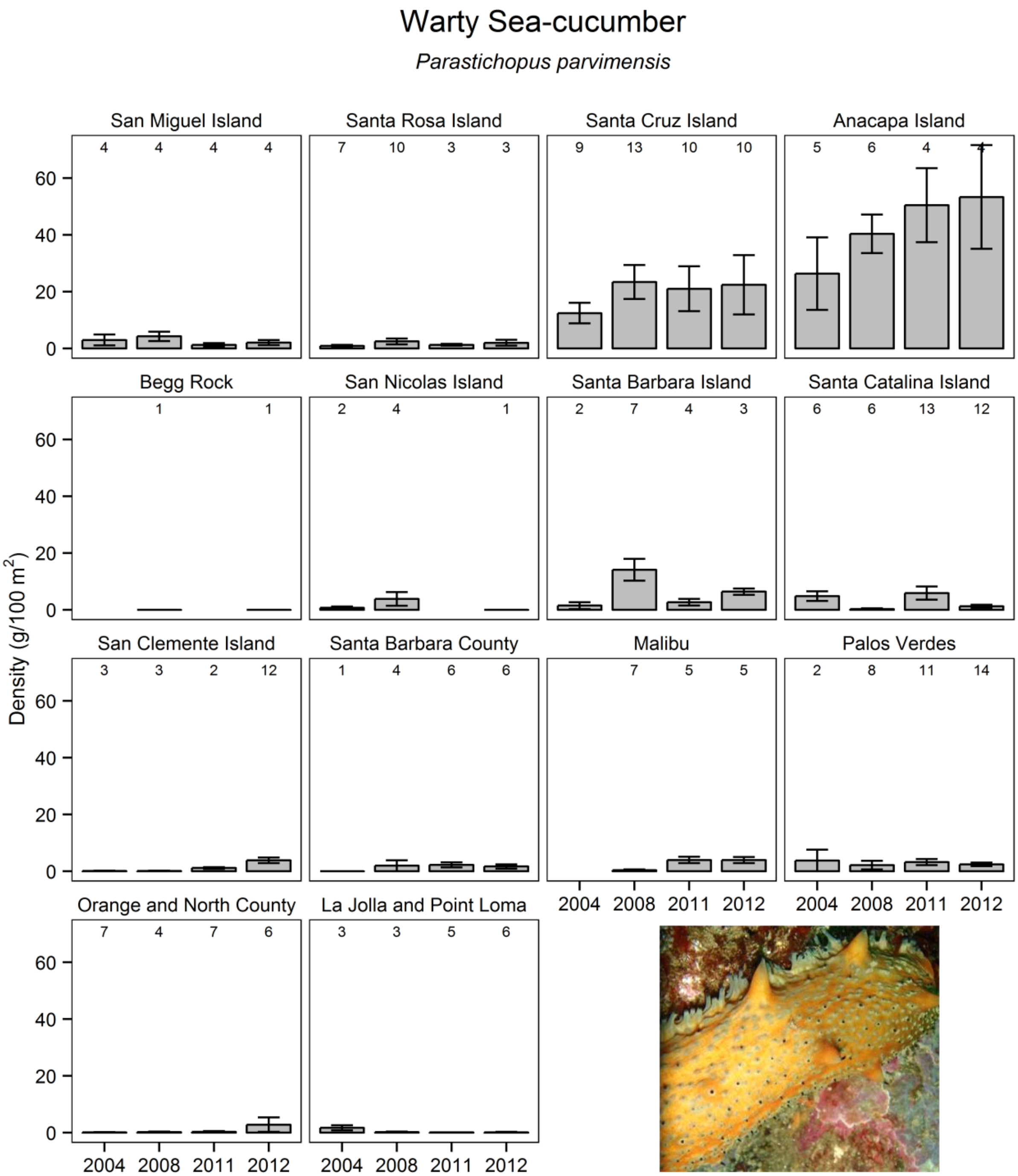


Figure D.35. *Parastichopus parvimensis* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

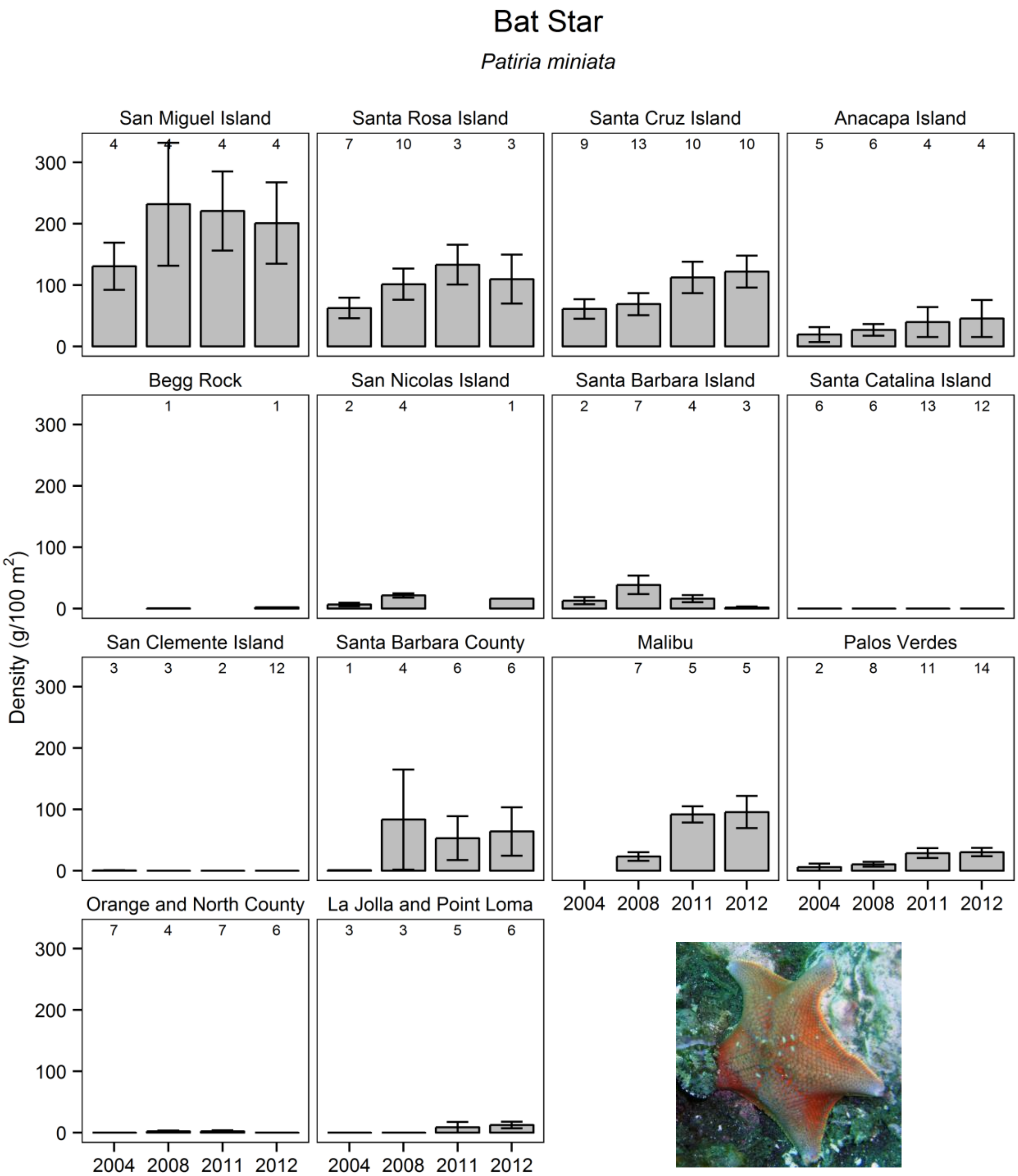


Figure D.36. *Patria miniata* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

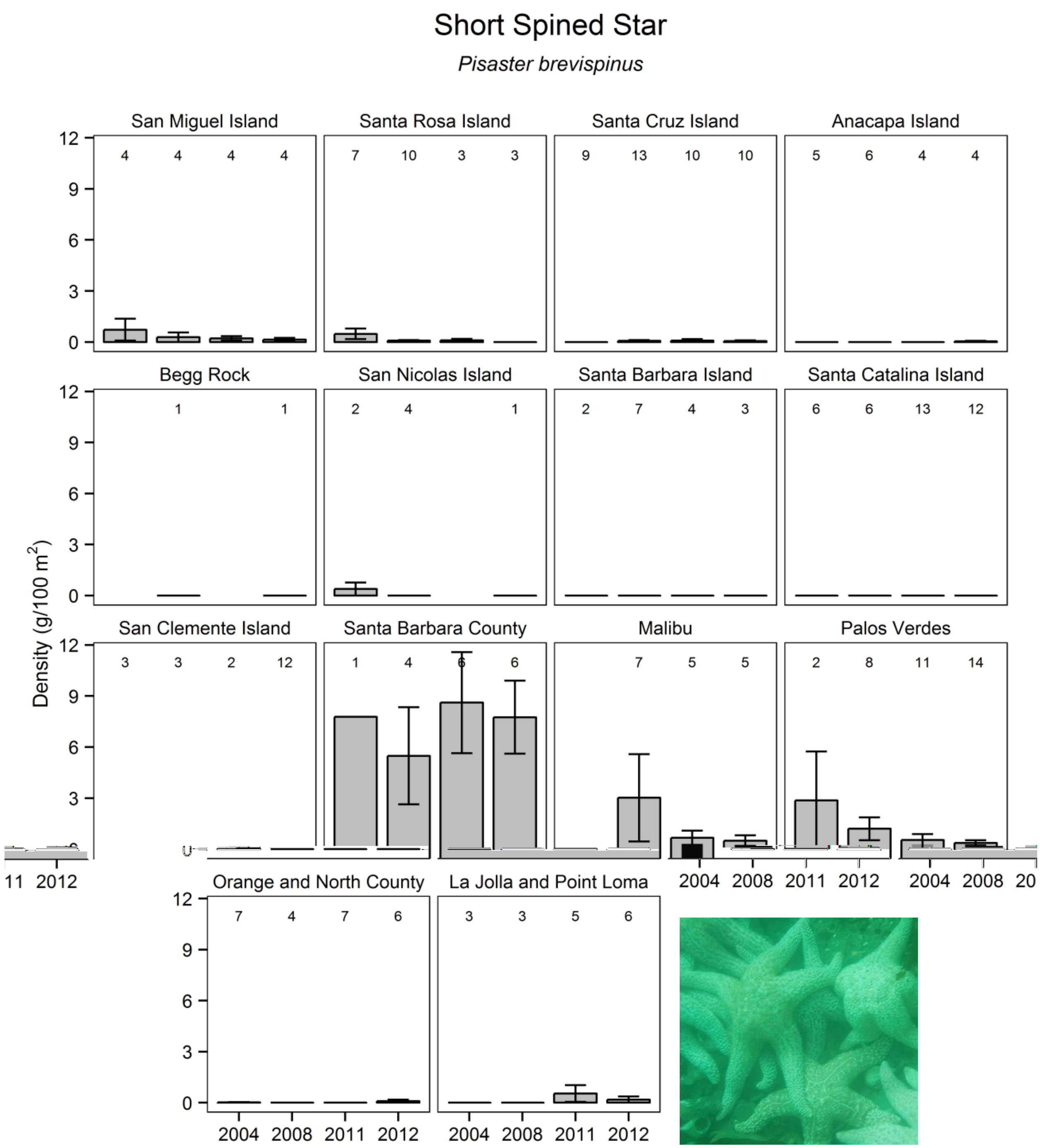


Figure D.37. *Pisaster brevispinus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

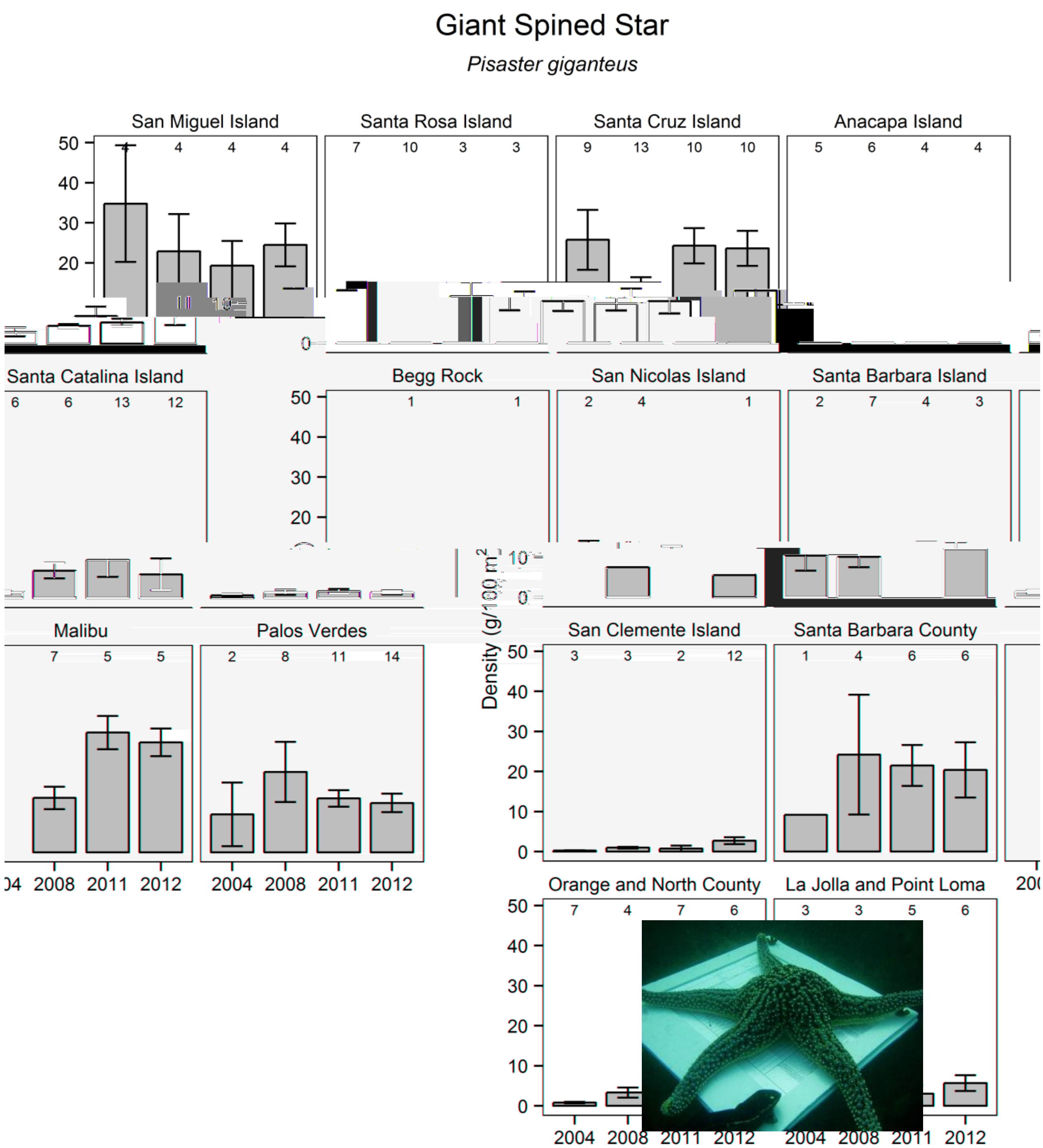


Figure D.38. *Pisaster giganteus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

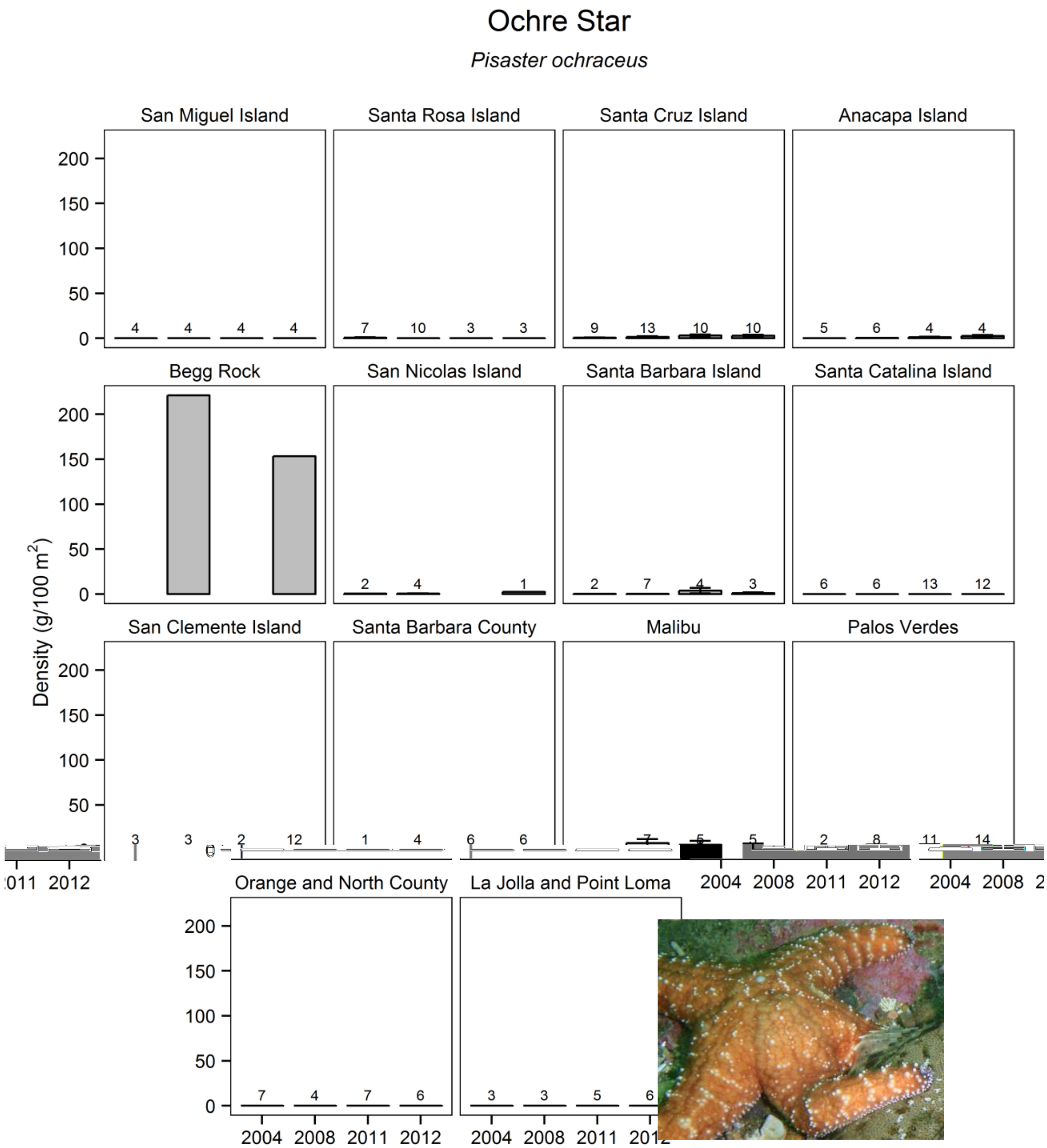


Figure D.39. *Pisaster ochraceus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

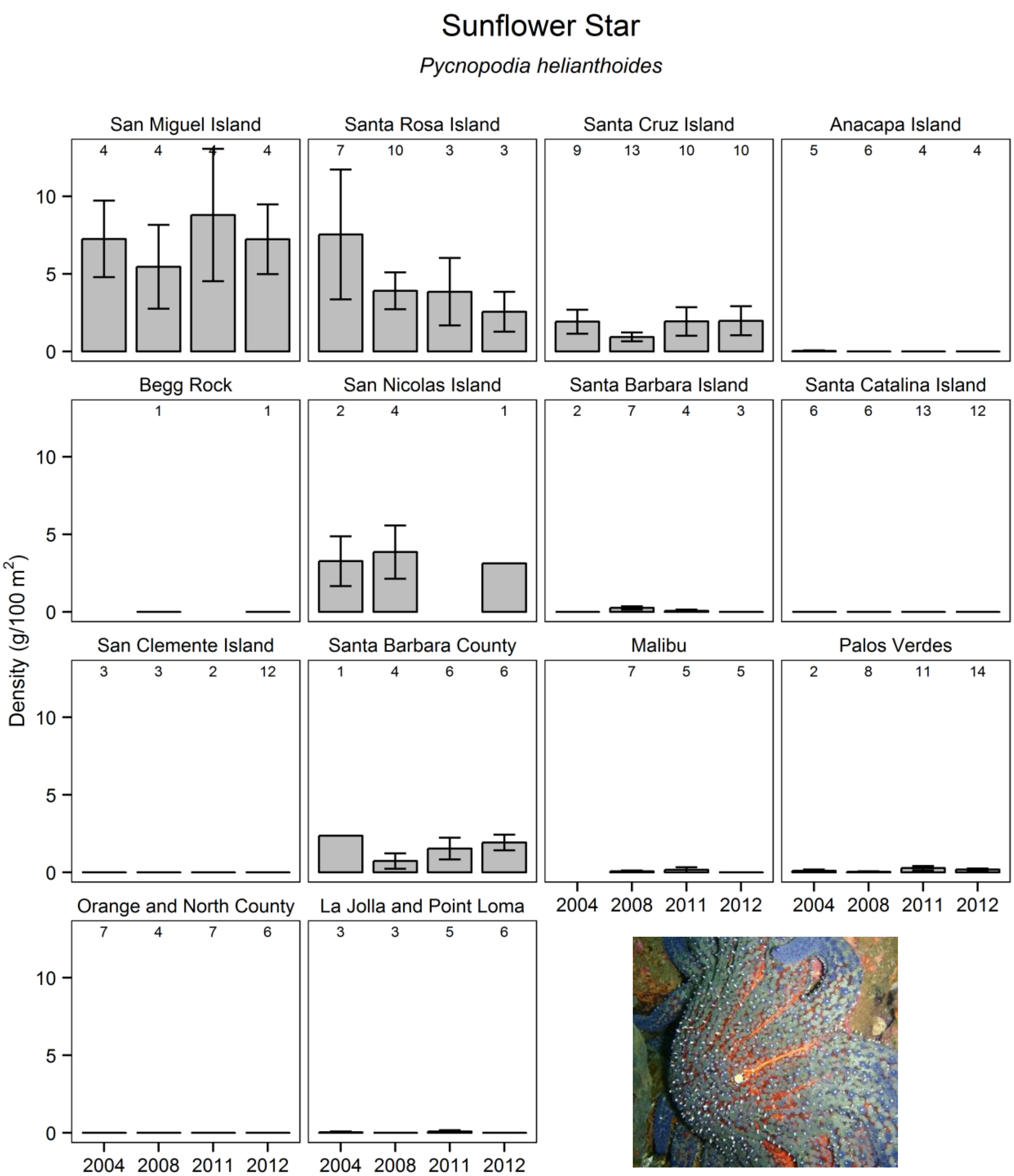


Figure D.40. *Pycnopodia helianthoides* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

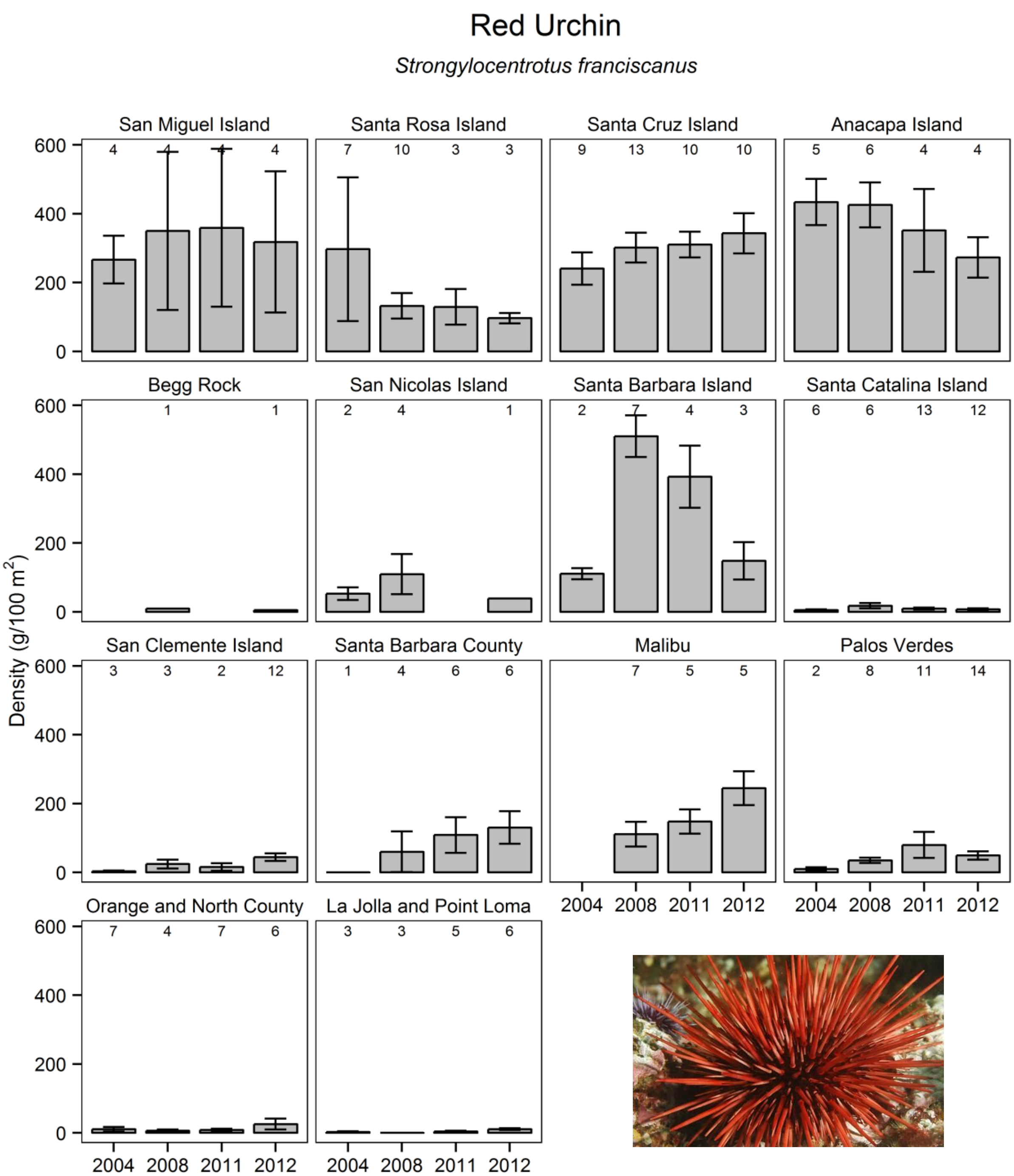


Figure D.41. *Strongylocentrotus franciscanus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

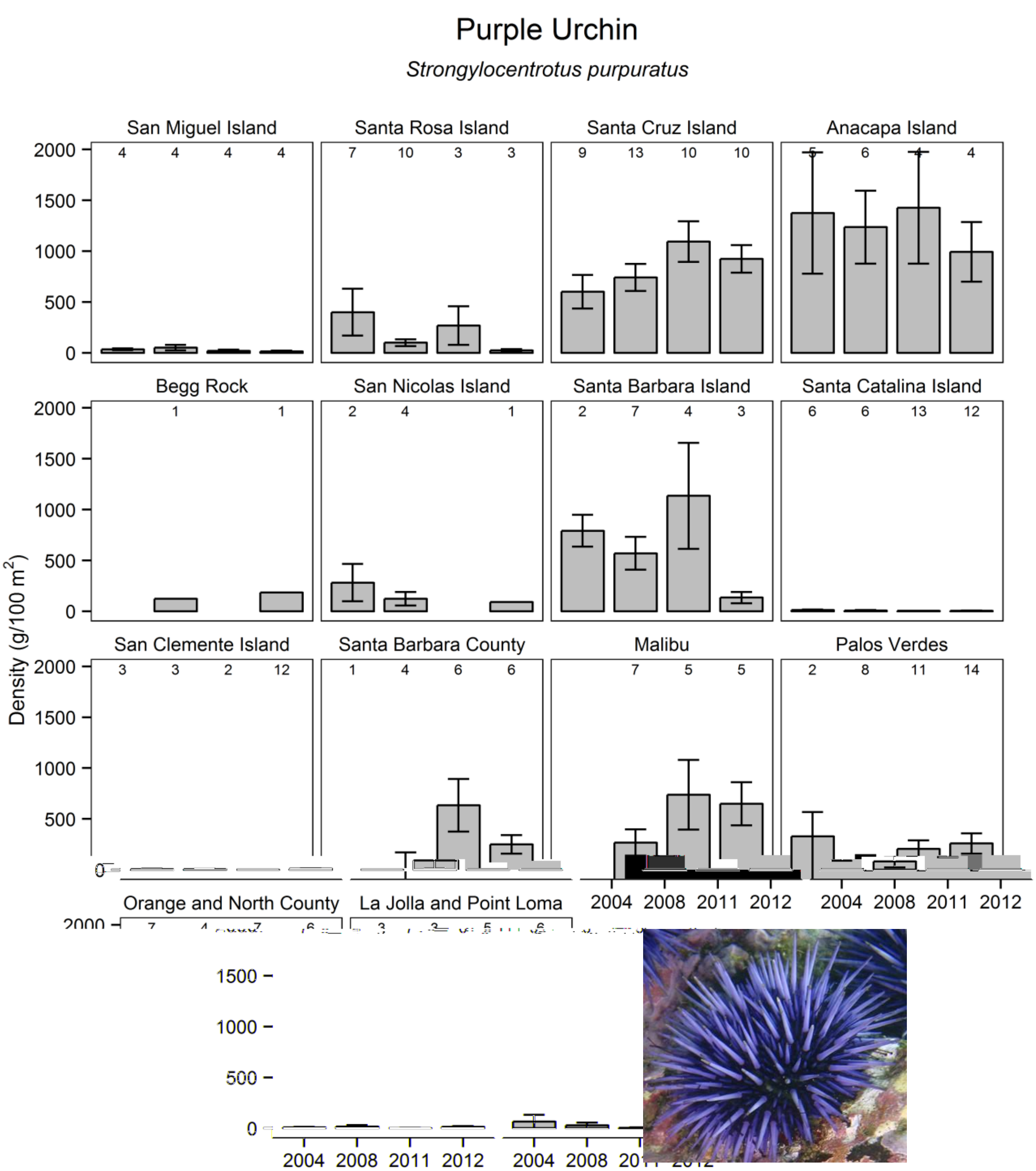


Figure D.42. *Strongylocentrotus purpuratus* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

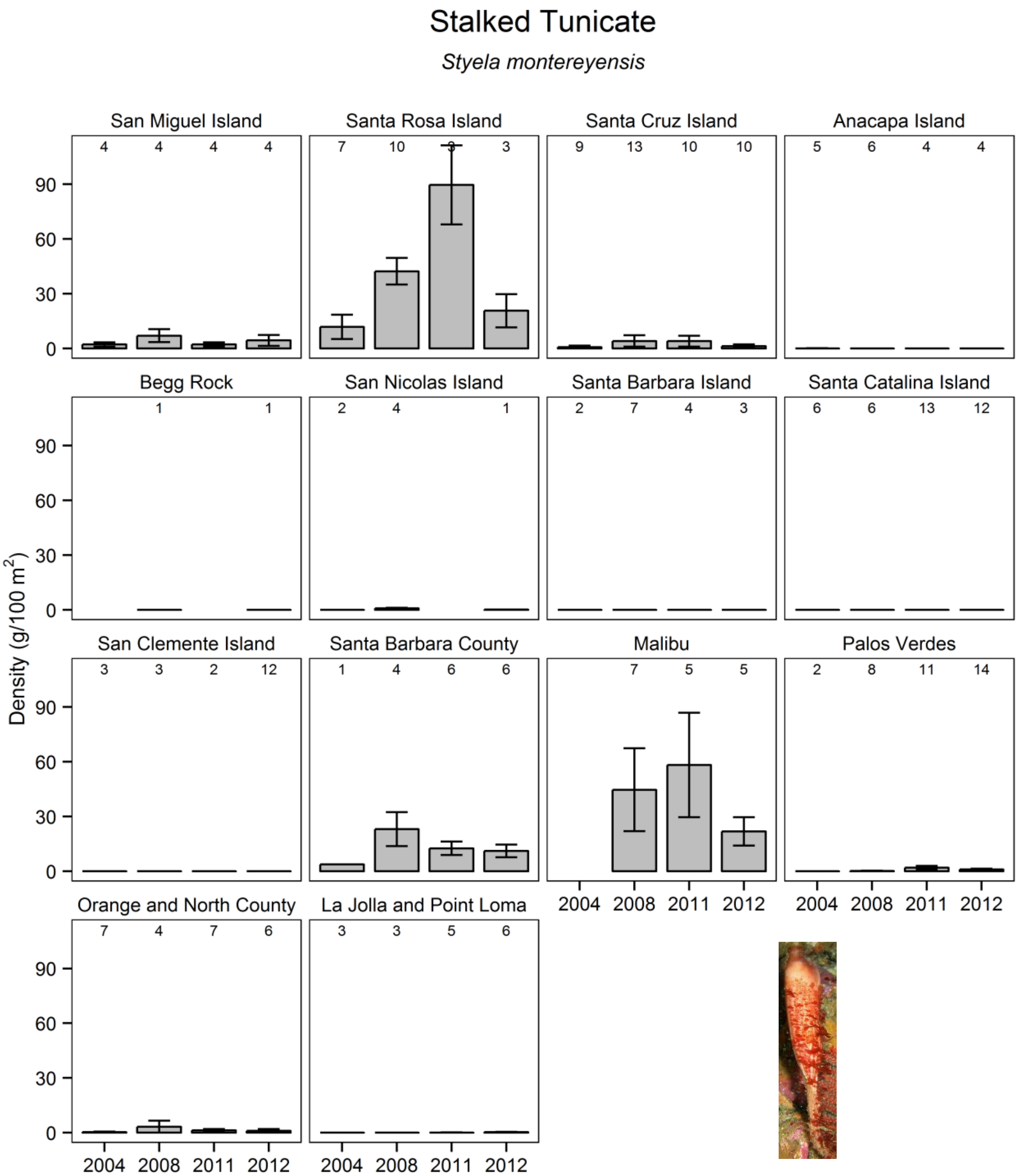


Figure D.43. *Styela montereyensis* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

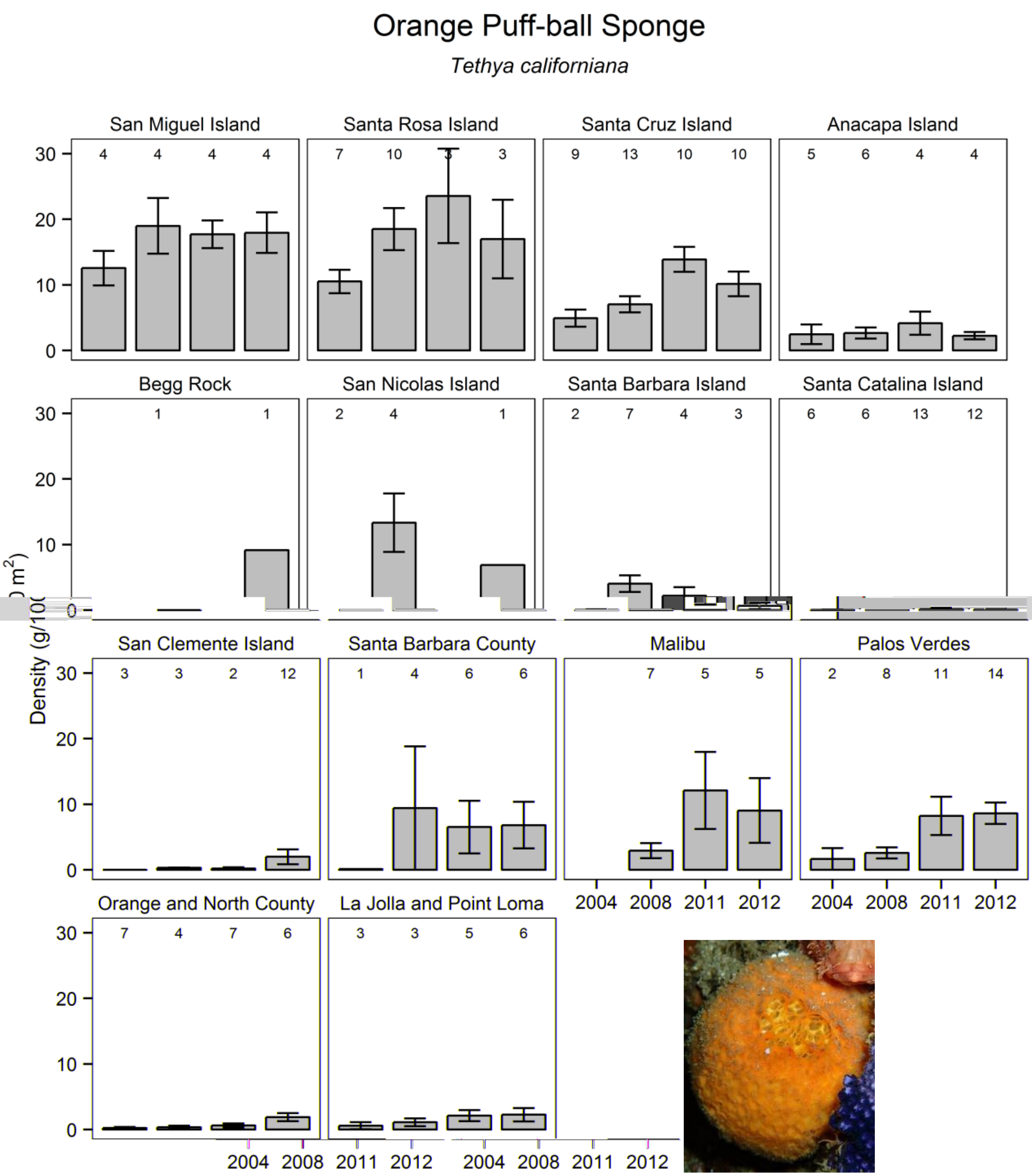


Figure D.44. *Tethya californiana* density with SE error bars by year for each Geographic Area. The number printed above each bar is the number of sites sampled during that year.

Appendix E

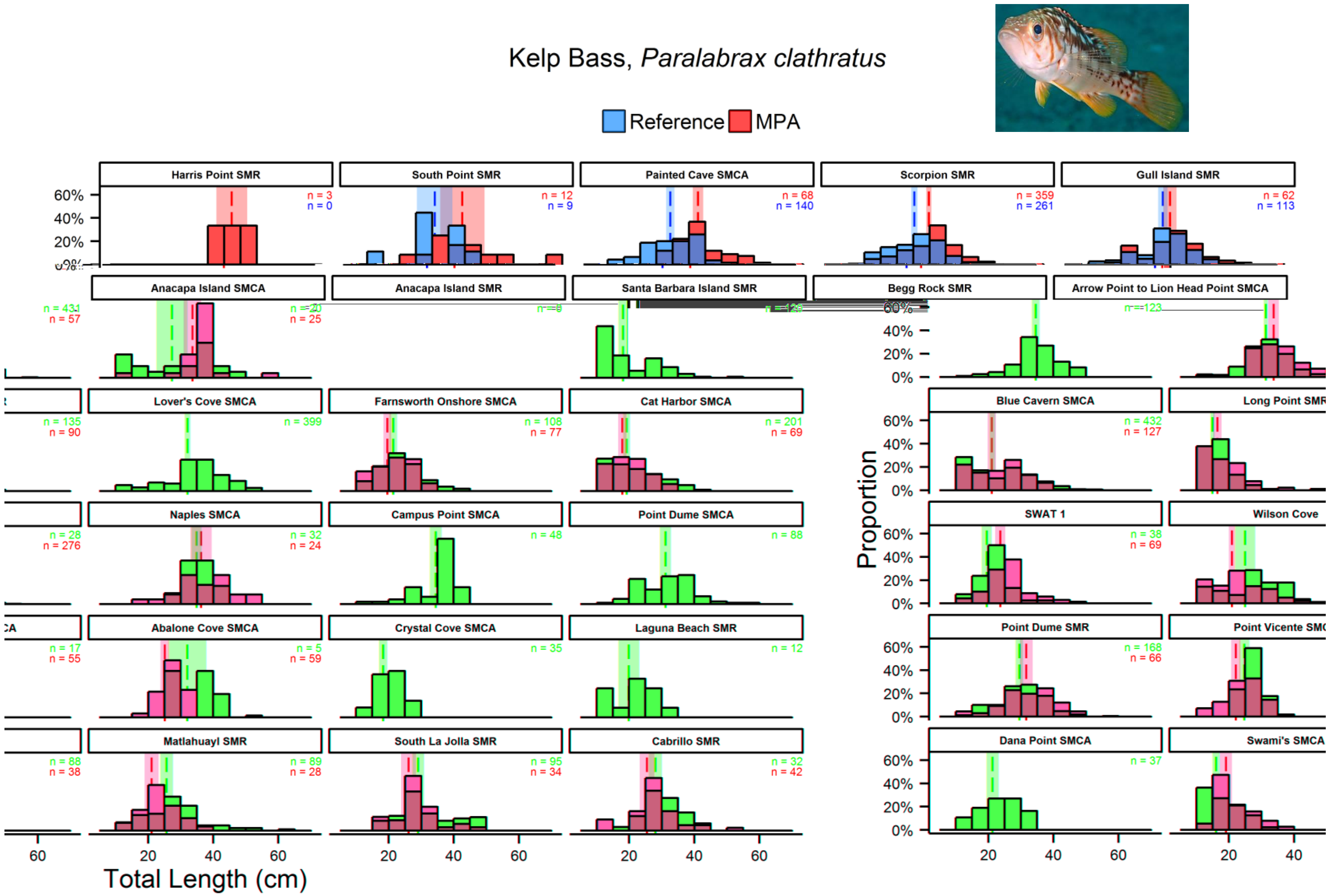


Figure E.1. Kelp Bass *Paralabrax clathratus* size structure by MPA (red bars) and reference (blue bars). The total number of fish observed is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

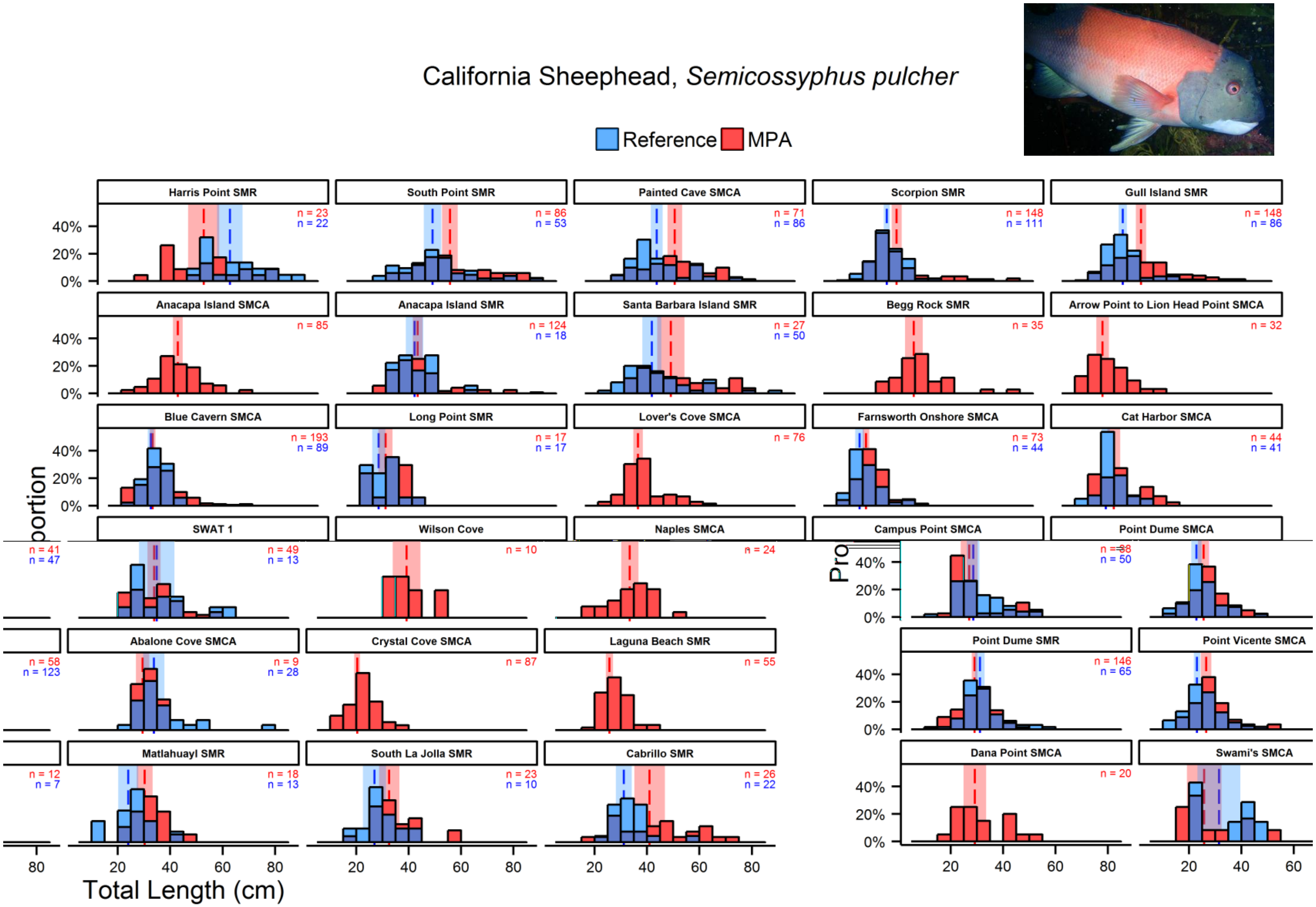


Figure E.2. California Sheephead *Semicossyphus pulcher* size structure by MPA (red bars) and reference (blue bars). The total number of fish observed is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

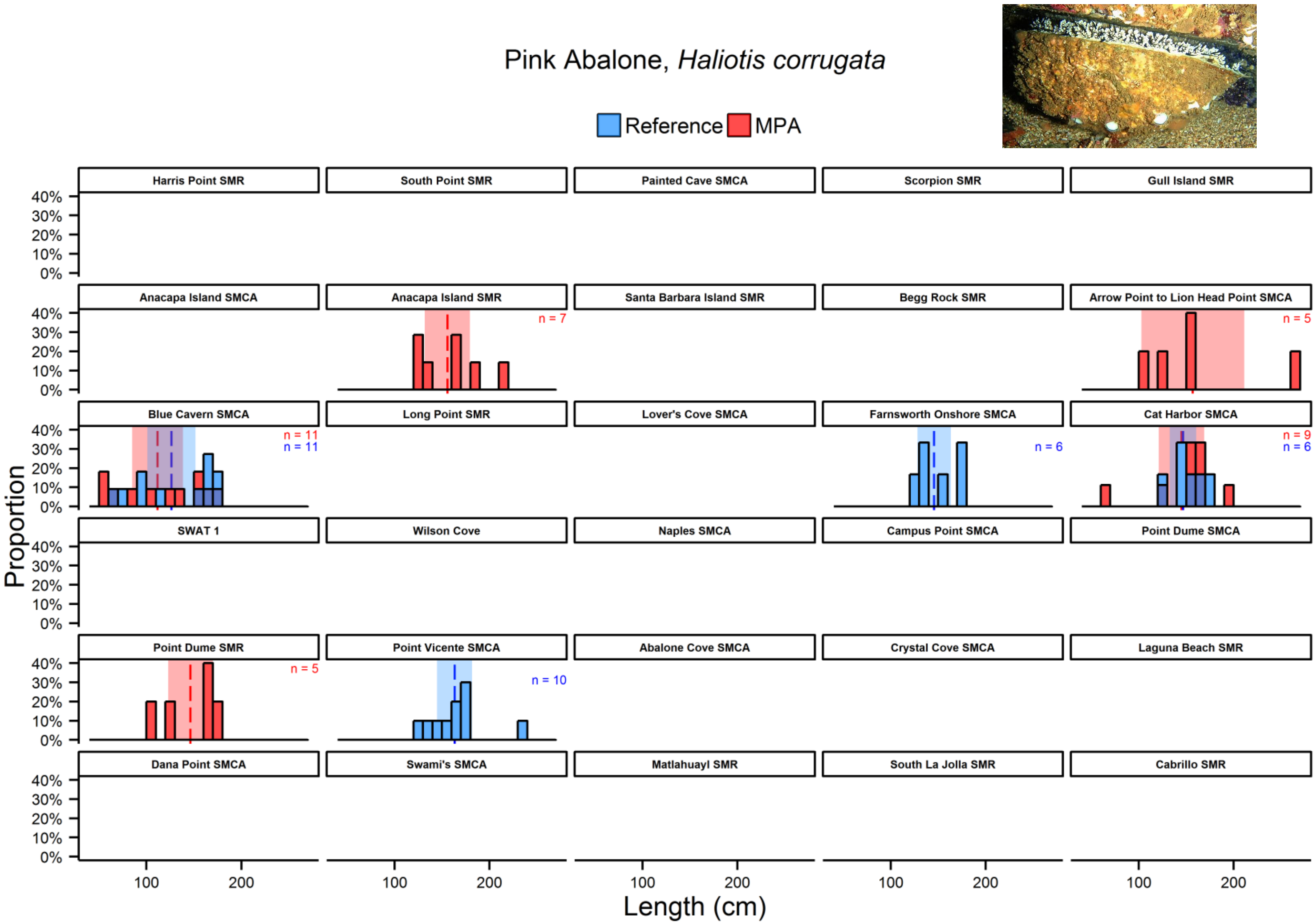


Figure E.3 *Haliotis corrugata* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

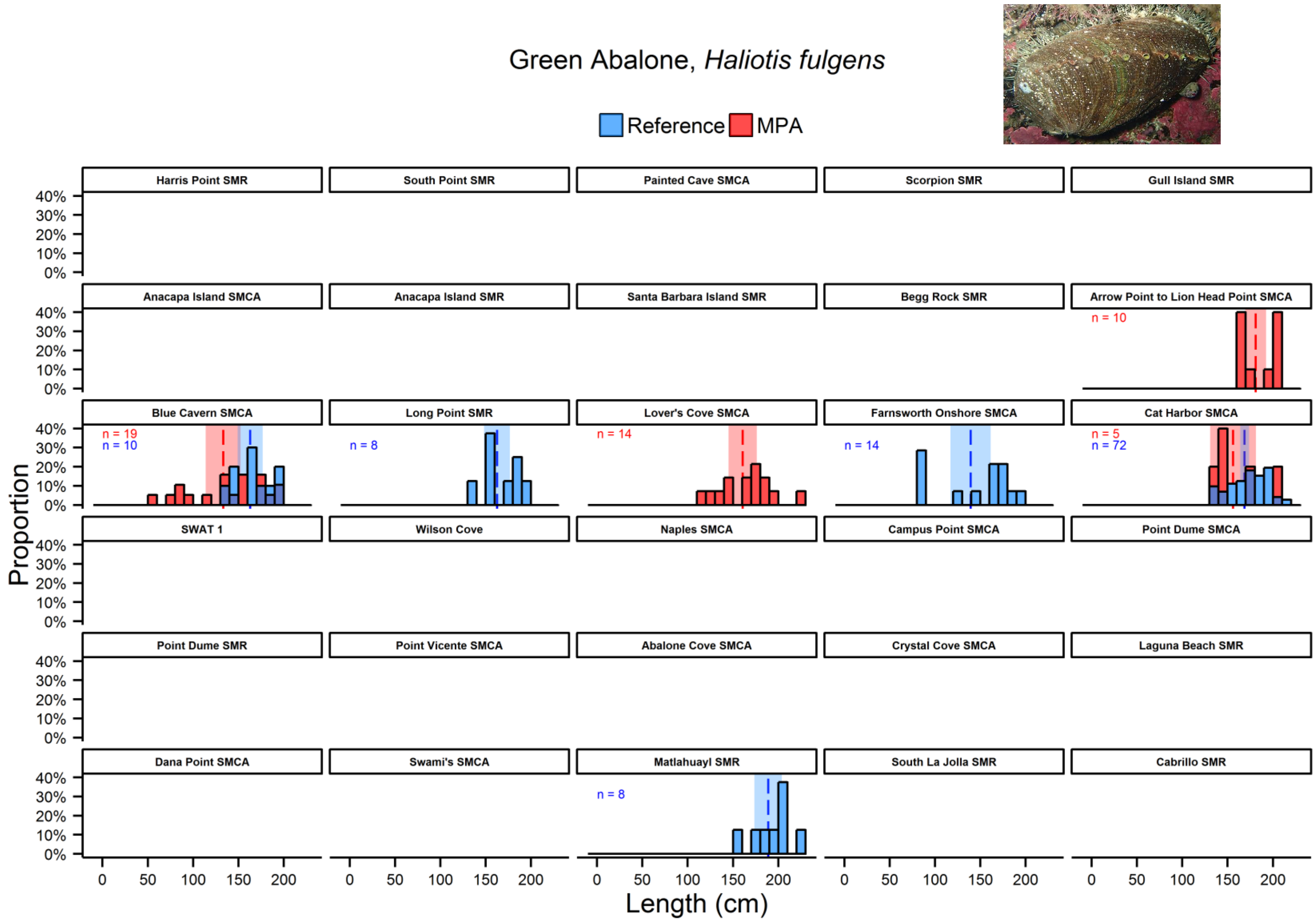


Figure E.4 *Haliotis fulgens* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

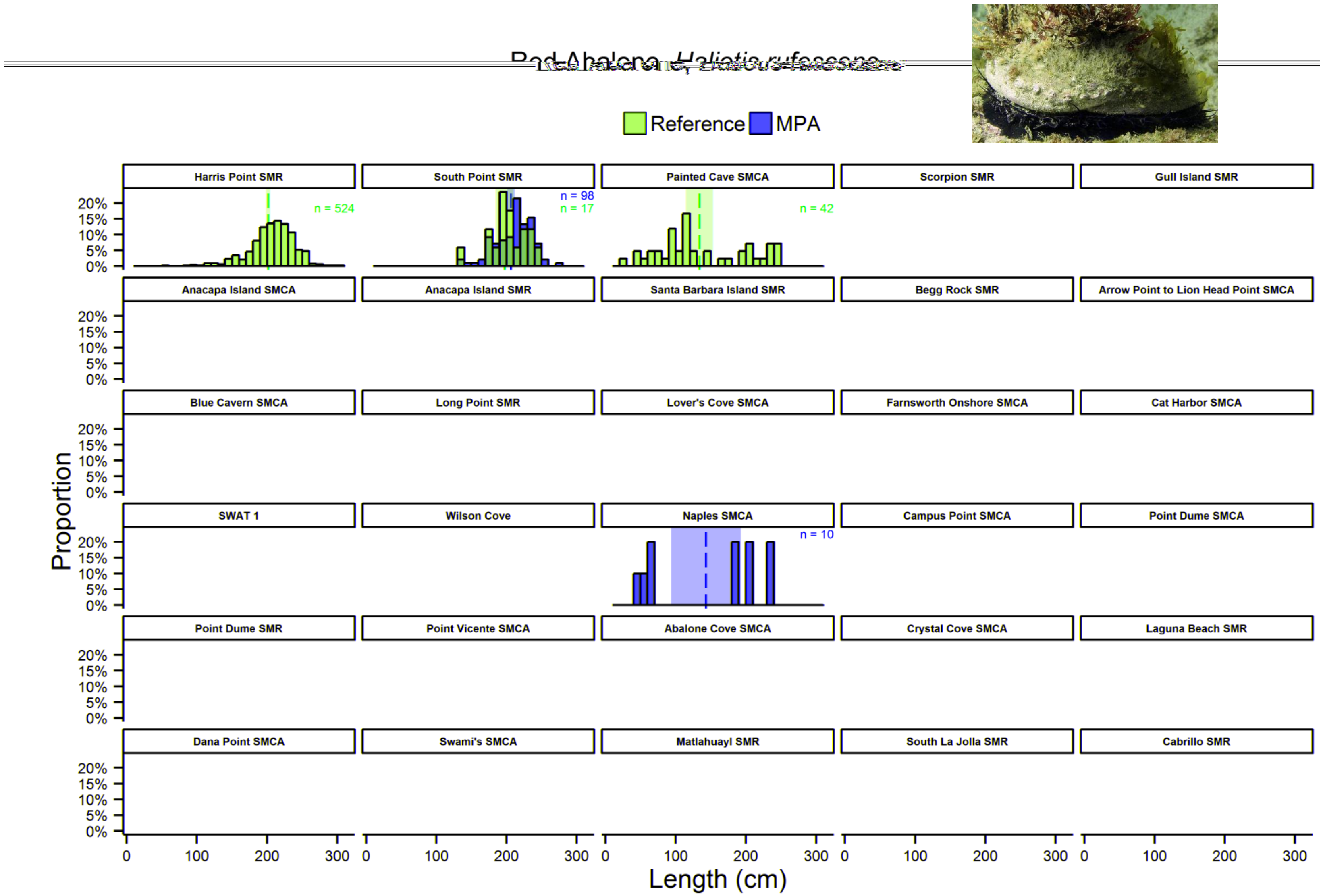


Figure E.5 *Haliotis rufescens* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

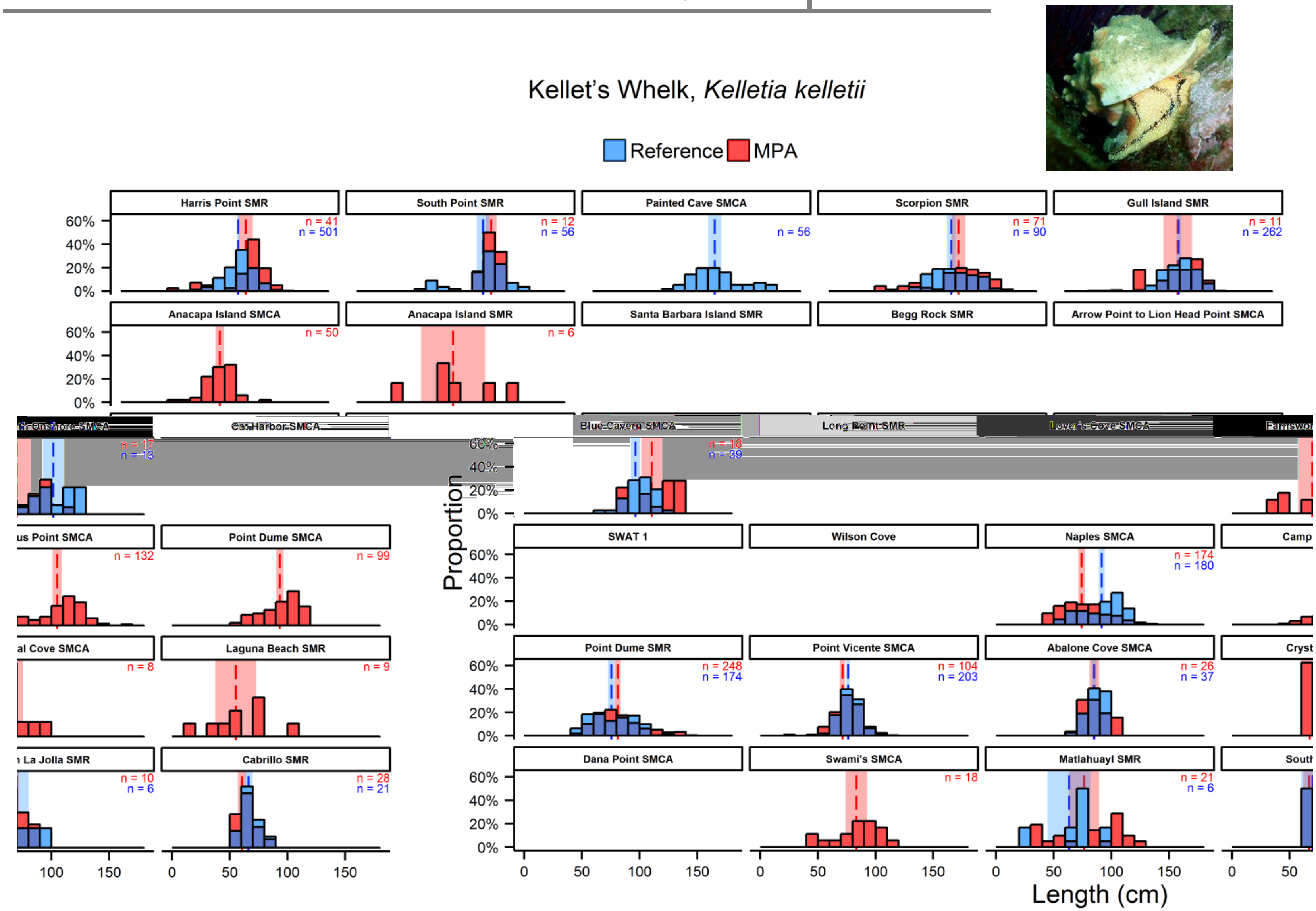


Figure E.6 *Kelletia kelletii* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

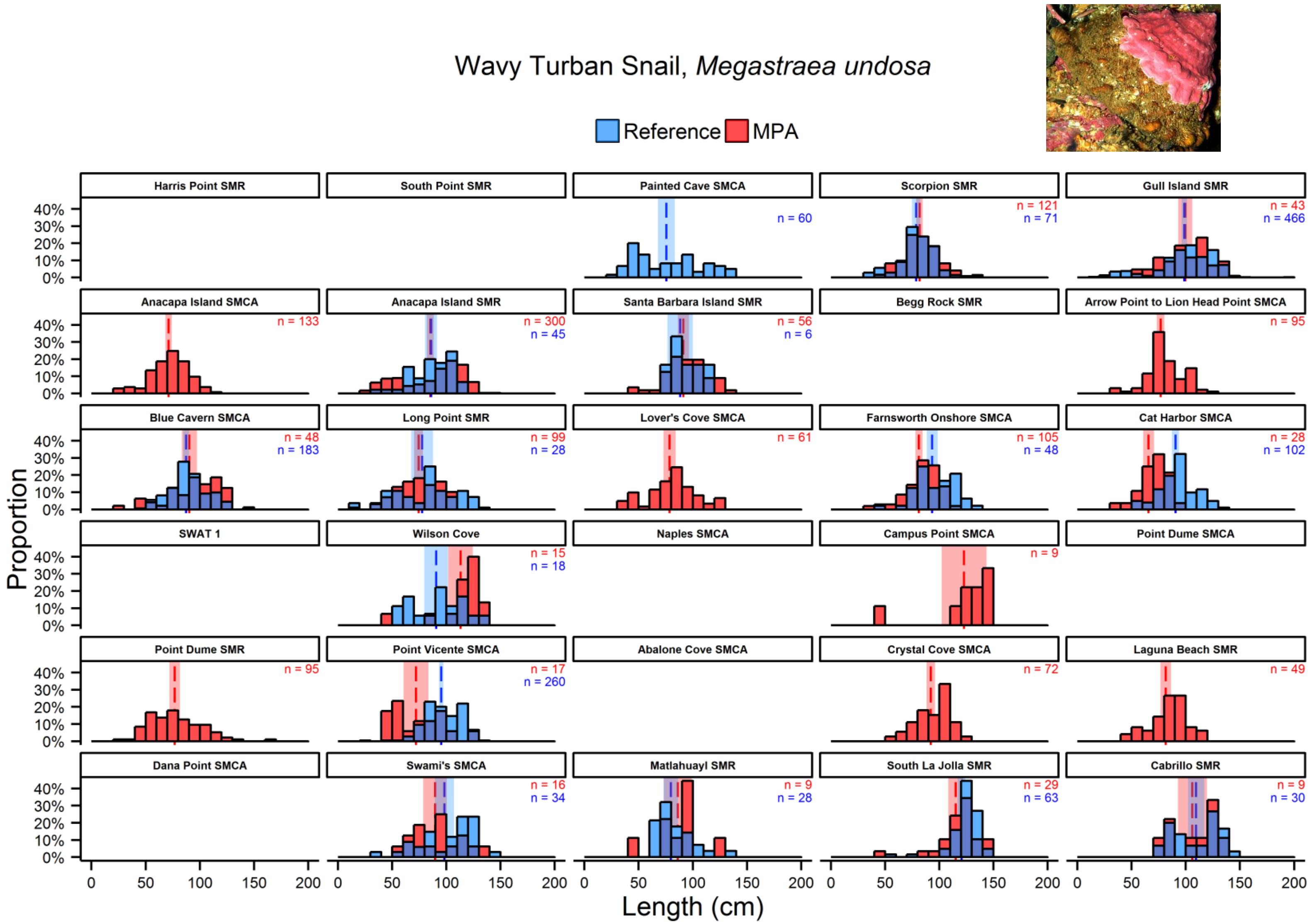


Figure E.7 *Megastrea undosa* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

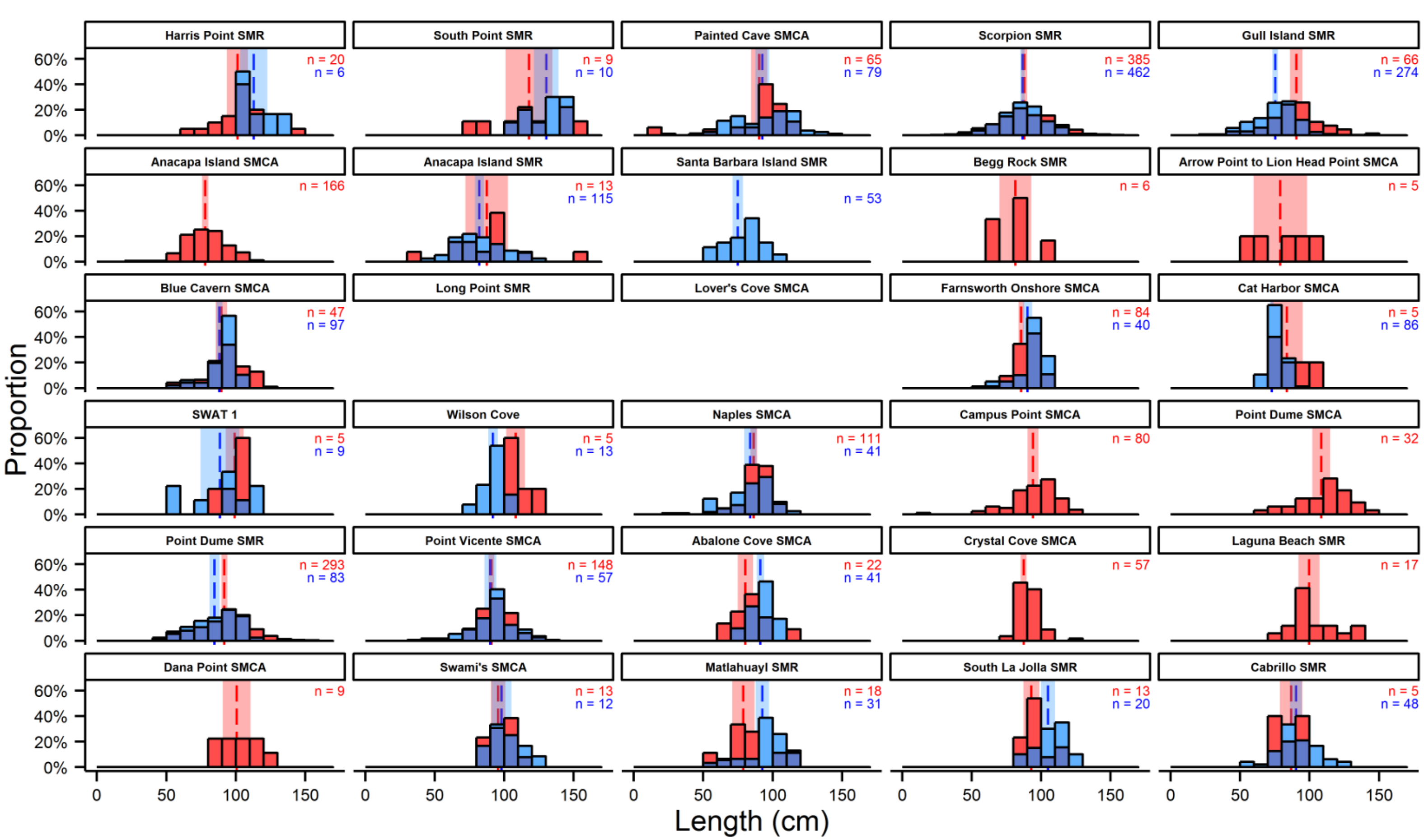


Figure E.9. *Megathura crenulata* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.=

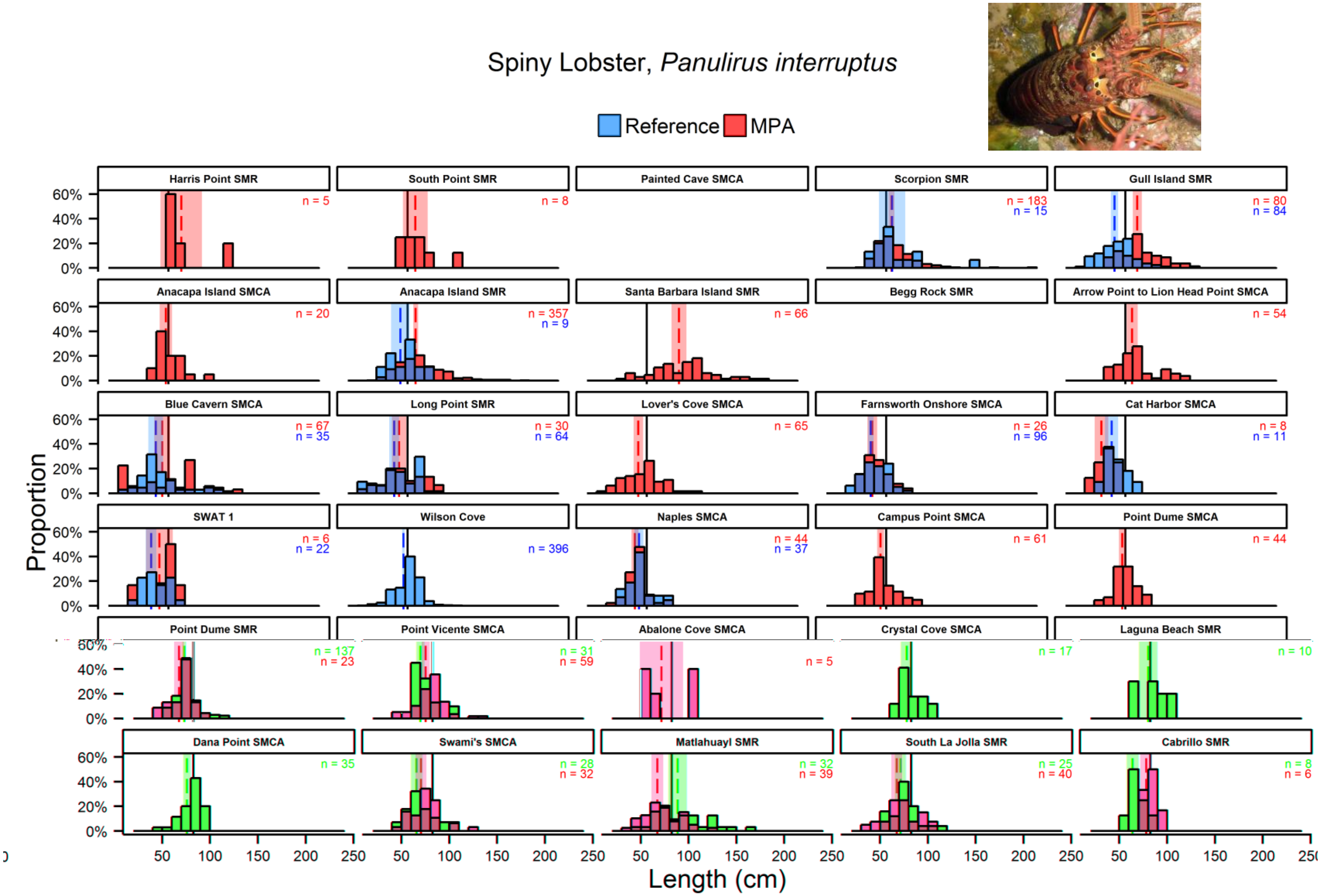


Figure E.10 *Panulirus interruptus* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

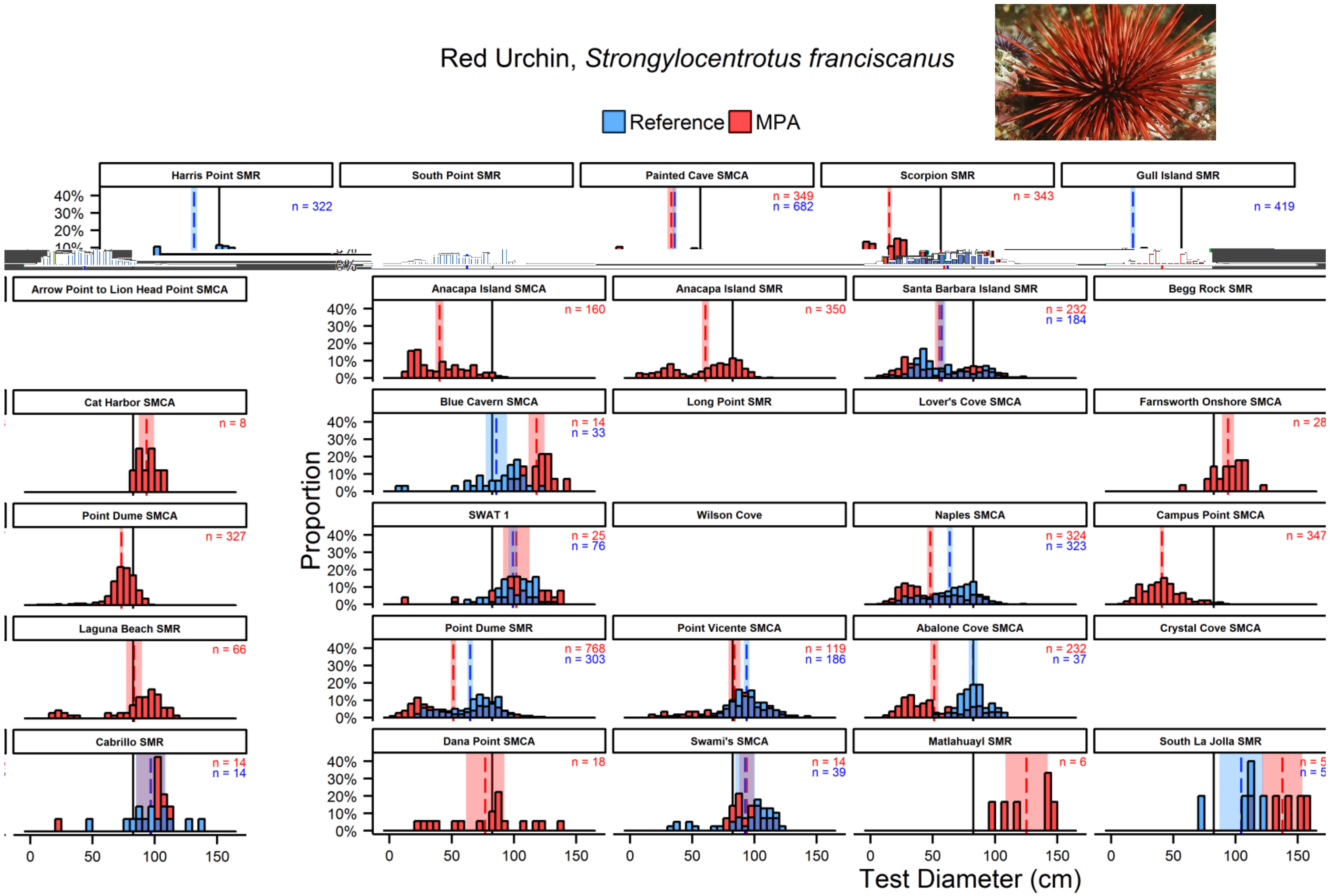


Figure E.11 *Strongylocentrotus franciscanus* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline sampling.

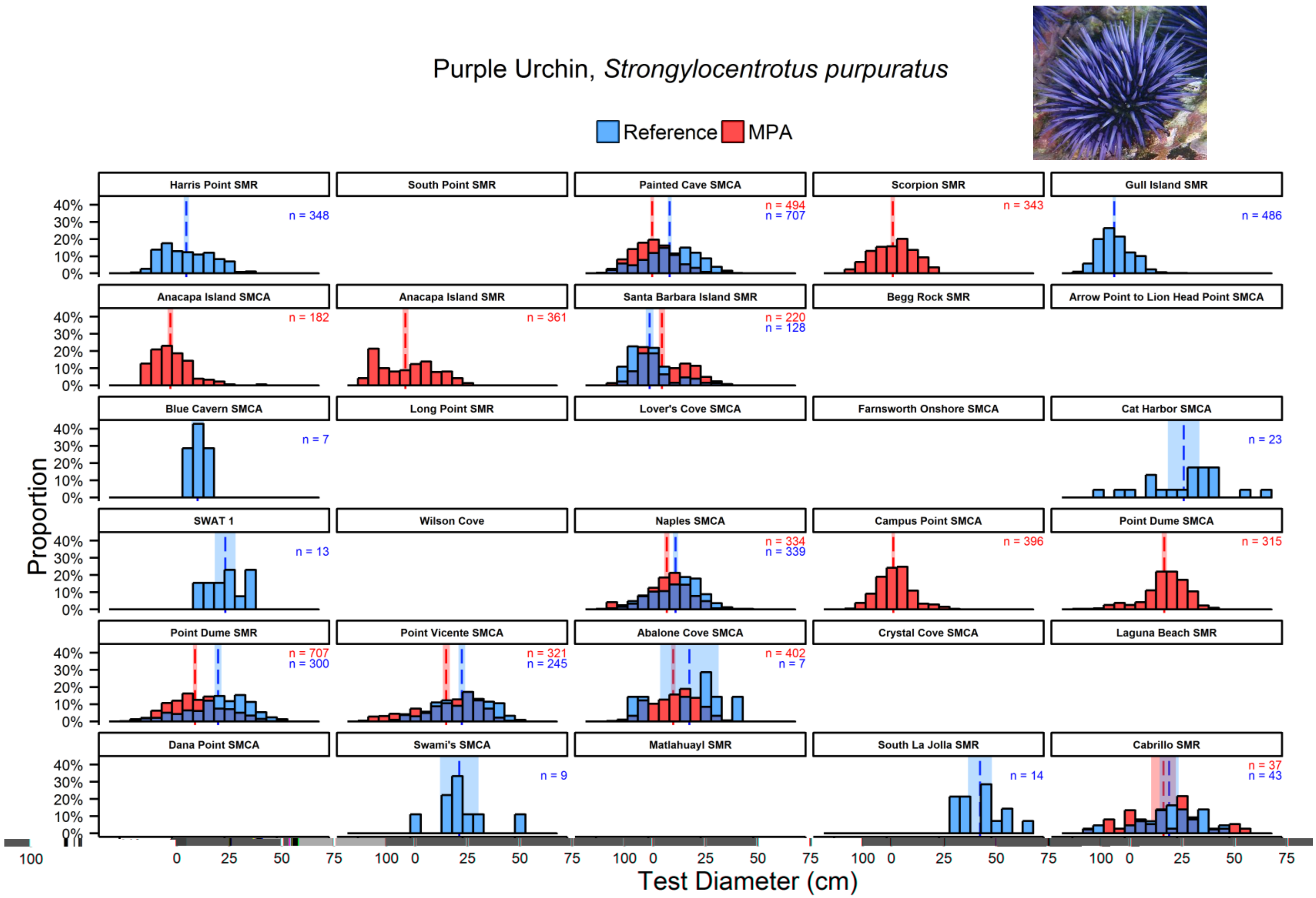


Figure E.12 *Strongylocentrotus purpuratus* size structure by MPA (red bars) and reference (blue bars). The total number measured is reported in each case, along with the mean size (dotted line) with 95% CI (shaded area). Data was pooled across all sites sampled during 2011 and 2012 baseline samplin

Appendix F

Table F.1. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Abalone Cove SMCA and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	0	0	0	0
	Laminaria farlowii	0	8.3 ± 6.1	0	10.6 ± 6.9
	Macrocystis pyrifera	33.8 ± 17.6	18.9 ± 7.0	7.9 ± 5.9	9.2 ± 4.6
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	34.2 ± 22.2	86.4 ± 30.9	7.9 ± 5.2	100.3 ± 52.5
Invertebrates	*Centrostephanus coronatus*	0	0	0	0
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	6.2 ± 4.6	3.9 ± 1.0	5.0 ± 2.0	5.8 ± 2.9
	Megastraea undosa	0	0.8 ± 0.6	0	0.6 ± 0.4
	Megathura crenulata	2.1 ± 1.0	0.3 ± 0.3	1.7 ± 0.7	2.8 ± 1.3
	Muricea californica	29.6 ± 17.2	35.0 ± 19.1	43.8 ± 27.0	26.7 ± 15.4
	Panulirus interruptus	0.4 ± 0.4	0.6 ± 0.6	0	0.8 ± 0.6
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	0.8 ± 0.8	7.2 ± 3.7	2.1 ± 0.8	9.4 ± 4.6
	Pisaster brevispinus	0	0	0.8 ± 0.5	0
	Pisaster giganteus	30.0 ± 3.0	11.4 ± 4.0	23.3 ± 8.5	10.0 ± 3.0
	Pisaster ochraceus	17.5 ± 7.8	0.6 ± 0.4	1.7 ± 1.0	1.7 ± 0.9
	Pycnopodia helianthoides	0.4 ± 0.4	0.3 ± 0.3	0.4 ± 0.4	0
	Strongylocentrotus franciscanus	444.6 ± 134.1	36.1 ± 13.2	162.9 ± 59.1	20.6 ± 6.1
	Strongylocentrotus purpuratus	674.2 ± 347.8	126.7 ± 114.1	562.9 ± 229.4	104.7 ± 49.9
	Styela montereyensis	11.2 ± 6.9	1.4 ± 0.9	2.5 ± 1.6	2.2 ± 0.9
	Tethya californiana	0.4 ± 0.4	1.1 ± 0.7	5.8 ± 5.8	1.9 ± 1.2

Table F.2. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Anacapa Island SMCA in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	0	—
	Eisenia arborea	28.9 ± 12.1	—	8.3 ± 6.9	—
	Laminaria farlowii	0.6 ± 0.4	—	1.2 ± 0.9	—
	Macrocystis pyrifera	2.5 ± 2.1	—	0	—
	Pelagophycus porra	0	—	0	—
	Pterygophora californica	0	—	0	—
Invertebrates	*Centrostephanus coronatus*	24.4 ± 5.1	—	15.4 ± 4.2	—
	Haliotis corrugata	0	—	0	—
	Haliotis fulgens	0	—	0	—
	Haliotis rufescens	0	—	0	—
	Kelletia kelletii	2.9 ± 2.5	—	1.1 ± 0.8	—
	Megastraea undosa	9.2 ± 3.6	—	1.9 ± 0.7	—
	Megathura crenulata	6.7 ± 1.8	—	6.2 ± 2.2	—
	Muricea californica	1.2 ± 0.6	—	0.1 ± 0.1	—
	Panulirus interruptus	0	—	0.1 ± 0.1	—
	Parastichopus californicus	0	—	0	—
	Parastichopus parvimensis	43.3 ± 13.1	—	45.0 ± 10.6	—
	Pisaster brevispinus	0	—	0.1 ± 0.1	—
	Pisaster giganteus	6.8 ± 1.6	—	13.6 ± 3.3	—
	Pisaster ochraceus	2.4 ± 0.8	—	5.0 ± 2.0	—
	Pycnopodia helianthoides	0	—	0	—
	Strongylocentrotus franciscanus	359.4 ± 72.3	—	238.2 ± 45.3	—
	Strongylocentrotus purpuratus	1448.1 ± 343.4	—	1258.2 ± 262.9	—
	Styela montereyensis	0	—	0	—
	Tethya californiana	2.2 ± 1.3	—	2.6 ± 1.6	—

Table F.3. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Anacapa Island SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	64.3 ± 17.3	29.2 ± 18.2	72.2 ± 19.0	39.2 ± 20.1
	Laminaria farlowii	282.5 ± 73.0	0	231.5 ± 55.8	1.7 ± 1.7
	Macrocystis pyrifera	40.9 ± 11.2	6.7 ± 4.3	47.8 ± 17.3	12.6 ± 6.0
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	23.8 ± 21.7	0	5.9 ± 5.2	0
Invertebrates	*Centrostephanus coronatus*	14.4 ± 4.0	4.4 ± 2.5	11.9 ± 3.7	5.7 ± 3.0
	Haliotis corrugata	0.1 ± 0.1	0	0.2 ± 0.1	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	0.4 ± 0.3	0	0.1 ± 0.1	0
	Megastraea undosa	14.2 ± 4.5	27.4 ± 17.9	6.2 ± 1.5	2.6 ± 1.0
	Megathura crenulata	0.4 ± 0.3	25.3 ± 5.7	0.1 ± 0.1	15.4 ± 3.8
	Muricea californica	0.7 ± 0.3	5.0 ± 2.9	0.5 ± 0.3	2.8 ± 1.3
	Panulirus interruptus	1.7 ± 0.6	0	2.0 ± 0.8	0
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	69.8 ± 10.0	18.8 ± 2.5	79.5 ± 11.0	9.2 ± 2.1
	Pisaster brevispinus	0	0	0	0
	Pisaster giganteus	4.2 ± 1.0	6.0 ± 1.7	4.7 ± 1.0	4.7 ± 1.4
	Pisaster ochraceus	0.5 ± 0.3	1.2 ± 0.4	1.2 ± 0.9	2.8 ± 1.3
	Pycnopodia helianthoides	0	0	0	0
	Strongylocentrotus franciscanus	178.3 ± 19.5	688.1 ± 120.8	203.5 ± 29.7	445.0 ± 78.9
	Strongylocentrotus purpuratus	738.3 ± 183.1	2780.4 ± 509.5	650.3 ± 167.1	1408.6 ± 320.9
	Styela montereyensis	0.1 ± 0.1	0	0	0
	Tethya californiana	2.6 ± 0.9	9.3 ± 4.7	1.4 ± 0.3	3.6 ± 2.0

Table F.4. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Arrow Point to Lion Head Point SMCA in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	5.0 ± 3.5	—
	Eisenia arborea	6.9 ± 5.3	—	12.5 ± 7.0	—
	Laminaria farlowii	12.5 ± 6.9	—	11.7 ± 7.4	—
	Macrocystis pyrifera	45.6 ± 9.5	—	59.7 ± 13.1	—
	Pelagophycus porra	0	—	0.8 ± 0.8	—
	Pterygophora californica	0	—	0	—
Invertebrates	*Centrostephanus coronatus*	139.7 ± 33.8	—	78.9 ± 24.5	—
	Haliotis corrugata	0.6 ± 0.4	—	0.3 ± 0.3	—
	Haliotis fulgens	0.8 ± 0.6	—	1.4 ± 0.5	—
	Haliotis rufescens	0	—	0	—
	Kelletia kelletii	1.1 ± 0.6	—	0.3 ± 0.3	—
	Megastraea undosa	28.3 ± 11.0	—	21.7 ± 8.9	—
	Megathura crenulata	0	—	0.6 ± 0.4	—
	Muricea californica	0.6 ± 0.4	—	1.7 ± 0.9	—
	Panulirus interruptus	4.2 ± 2.4	—	8.3 ± 5.4	—
	Parastichopus californicus	0	—	0	—
	Parastichopus parvimensis	31.4 ± 16.6	—	2.5 ± 1.9	—
	Pisaster brevispinus	0	—	0	—
	Pisaster giganteus	1.7 ± 0.9	—	1.9 ± 1.6	—
	Pisaster ochraceus	0	—	0	—
	Pycnopodia helianthoides	0	—	0	—
	Strongylocentrotus franciscanus	9.4 ± 1.6	—	0.8 ± 0.4	—
	Strongylocentrotus purpuratus	5.3 ± 2.4	—	1.4 ± 0.5	—
	Styela montereyensis	0	—	0	—
	Tethya californiana	0	—	0.6 ± 0.6	—

Table F.5. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Begg Rock SMR in 2012.

	Kelps and benthic macroinvertebrates	**2011**		**2012**	
		MPA	**Reference**	**MPA**	**Reference**
Kelps	*Agarum fimbriatum*	—	—	0	—
	Eisenia arborea	—	—	0	—
	Laminaria farlowii	—	—	0	—
	Macrocystis pyrifera	—	—	0	—
	Pelagophycus porra	—	—	0	—
	Pterygophora californica	—	—	0	—
Invertebrates	*Centrostephanus coronatus*	—	—	0	—
	Haliotis corrugata	—	—	0	—
	Haliotis fulgens	—	—	0	—
	Haliotis rufescens	—	—	0	—
	Kelletia kelletii	—	—	0	—
	Megastraea undosa	—	—	0	—
	Megathura crenulata	—	—	4.4 ± 2.5	—
	Muricea californica	—	—	0	—
	Panulirus interruptus	—	—	0	—
	Parastichopus californicus	—	—	0	—
	Parastichopus parvimensis	—	—	0	—
	Pisaster brevispinus	—	—	0	—
	Pisaster giganteus	—	—	5.6 ± 3.0	—
	Pisaster ochraceus	—	—	153.3 ± 36.2	—
	Pycnopodia helianthoides	—	—	0	—
	Strongylocentrotus franciscanus	—	—	4.7 ± 3.0	—
	Strongylocentrotus purpuratus	—	—	183.6 ± 157.3	—
	Styela montereyensis	—	—	0	—
	Tethya californiana	—	—	9.2 ± 8.2	—

Table F.6. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Blue Cavern SMCA and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	18.9 ± 7.4	38.2 ± 17.3	30.4 ± 11.9	52.6 ± 32.9
	Eisenia arborea	29.4 ± 9.9	14.9 ± 5.7	20.5 ± 7.7	10.6 ± 4.9
	Laminaria farlowii	23.3 ± 9.8	3.2 ± 1.6	25.2 ± 8.4	2.4 ± 1.2
	Macrocystis pyrifera	22.0 ± 4.8	18.8 ± 4.8	32.1 ± 6.8	23.6 ± 5.4
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	0	0	0
Invertebrates	*Centrostephanus coronatus*	59.2 ± 12.0	34.9 ± 7.4	62.0 ± 15.6	46.5 ± 9.6
	Haliotis corrugata	0.2 ± 0.1	0.3 ± 0.2	0.6 ± 0.3	0.8 ± 0.6
	Haliotis fulgens	1.7 ± 0.7	1.2 ± 0.8	0.7 ± 0.6	0.6 ± 0.3
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	0.8 ± 0.3	4.6 ± 1.2	0.2 ± 0.2	0.7 ± 0.3
	Megastraea undosa	3.6 ± 1.3	8.8 ± 4.8	1.9 ± 0.8	20.3 ± 7.9
	Megathura crenulata	4.0 ± 1.2	7.2 ± 2.3	3.2 ± 1.5	5.6 ± 2.2
	Muricea californica	1.7 ± 1.4	0.7 ± 0.5	3.5 ± 2.1	2.2 ± 0.8
	Panulirus interruptus	3.0 ± 1.5	3.3 ± 1.9	2.6 ± 1.2	2.8 ± 1.2
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	6.2 ± 1.5	5.1 ± 1.5	1.2 ± 0.5	0.4 ± 0.3
	Pisaster brevispinus	0	0	0	0
	Pisaster giganteus	4.3 ± 0.9	0.7 ± 0.3	3.5 ± 1.5	1.2 ± 0.7
	Pisaster ochraceus	0	0	0	0
	Pycnopodia helianthoides	0	0	0	0
	Strongylocentrotus franciscanus	5.5 ± 1.7	15.0 ± 5.9	3.2 ± 1.6	13.1 ± 4.3
	Strongylocentrotus purpuratus	0.8 ± 0.3	3.2 ± 1.6	1.2 ± 0.7	5.6 ± 4.1
	Styela montereyensis	0	0	0	0
	Tethya californiana	0.8 ± 0.4	0	0.4 ± 0.4	0

Table F.7. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Cabrillo SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	0	8.5 ± 7.4
	Eisenia arborea	0	—	0.3 ± 0.3	6.5 ± 4.5
	Laminaria farlowii	5.8 ± 2.9	—	24.4 ± 12.1	30.8 ± 24.9
	Macrocystis pyrifera	19.6 ± 7.2	—	11.4 ± 2.9	9.2 ± 4.3
	Pelagophycus porra	0	—	0.3 ± 0.3	12.5 ± 8.4
	Pterygophora californica	78.3 ± 27.3	—	116.4 ± 31.2	7.5 ± 5.6
Invertebrates	*Centrostephanus coronatus*	0	—	0	0
	Haliotis corrugata	0	—	0	0
	Haliotis fulgens	0	—	0	0.4 ± 0.4
	Haliotis rufescens	0	—	0	0
	Kelletia kelletii	2.5 ± 2.0	—	3.6 ± 2.3	2.9 ± 0.9
	Megastraea undosa	1.2 ± 0.8	—	1.9 ± 0.9	2.5 ± 1.2
	Megathura crenulata	0	—	1.4 ± 0.5	7.9 ± 4.5
	Muricea californica	0	—	0	0
	Panulirus interruptus	1.7 ± 1.2	—	0.6 ± 0.4	1.0 ± 0.5
	Parastichopus californicus	0	—	0	0
	Parastichopus parvimensis	0	—	0	0
	Pisaster brevispinus	2.5 ± 2.0	—	1.1 ± 0.6	0
	Pisaster giganteus	11.7 ± 4.1	—	11.7 ± 4.2	11.5 ± 4.8
	Pisaster ochraceus	0	—	0	0
	Pycnopodia helianthoides	0.4 ± 0.4	—	0	0
	Strongylocentrotus franciscanus	7.9 ± 3.8	—	6.1 ± 3.3	18.3 ± 9.9
	Strongylocentrotus purpuratus	16.7 ± 13.1	—	12.2 ± 10.9	62.1 ± 30.9
	Styela montereyensis	0.4 ± 0.4	—	0.6 ± 0.4	1.0 ± 0.8
	Tethya californiana	4.2 ± 2.5	—	3.3 ± 2.2	6.7 ± 2.9

Table F.8. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Campus Point SMCA in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	0	—
	Eisenia arborea	0	—	0	—
	Laminaria farlowii	0	—	0	—
	Macrocystis pyrifera	14.7 ± 6.7	—	74.6 ± 43.3	—
	Pelagophycus porra	0	—	0	—
	Pterygophora californica	162.2 ± 88.0	—	82.5 ± 66.5	—
Invertebrates	*Centrostephanus coronatus*	0	—	0	—
	Haliotis corrugata	0	—	0	—
	Haliotis fulgens	0	—	0	—
	Haliotis rufescens	0	—	0	—
	Kelletia kelletii	3.9 ± 1.4	—	6.1 ± 4.4	—
	Megastraea undosa	0	—	0.1 ± 0.1	—
	Megathura crenulata	1.4 ± 0.6	—	1.1 ± 0.4	—
	Muricea californica	2.6 ± 1.6	—	1.4 ± 1.1	—
	Panulirus interruptus	0	—	0	—
	Parastichopus californicus	0	—	0	—
	Parastichopus parvimensis	1.2 ± 0.5	—	1.7 ± 0.8	—
	Pisaster brevispinus	12.1 ± 1.9	—	12.8 ± 4.6	—
	Pisaster giganteus	37.8 ± 6.2	—	48.8 ± 13.2	—
	Pisaster ochraceus	0.3 ± 0.2	—	0.1 ± 0.1	—
	Pycnopodia helianthoides	0.7 ± 0.4	—	2.1 ± 1.1	—
	Strongylocentrotus franciscanus	125.6 ± 48.5	—	221.0 ± 64.2	—
	Strongylocentrotus purpuratus	1596.2 ± 373.2	—	437.5 ± 79.4	—
	Styela montereyensis	1.5 ± 1.1	—	14.3 ± 8.7	—
	Tethya californiana	9.0 ± 5.3	—	7.9 ± 3.7	—

Table F.9. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Cat Harbor SMCA and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	1.7 ± 0.9	24.4 ± 11.0	0	35.8 ± 20.8
	Laminaria farlowii	12.8 ± 5.0	25.6 ± 6.5	4.2 ± 2.8	85.3 ± 45.1
	Macrocystis pyrifera	29.4 ± 9.0	23.3 ± 3.5	40.8 ± 9.6	7.5 ± 2.3
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	0	0	0
Invertebrates	*Centrostephanus coronatus*	10.0 ± 6.9	30.8 ± 18.8	18.6 ± 8.6	3.1 ± 2.1
	Haliotis corrugata	0	0.3 ± 0.3	1.9 ± 0.9	1.4 ± 0.9
	Haliotis fulgens	0.6 ± 0.6	1.1 ± 0.6	0.6 ± 0.6	15.6 ± 6.7
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	0	0.3 ± 0.3	0.8 ± 0.6	0
	Megastraea undosa	4.4 ± 2.6	15.0 ± 7.2	0.8 ± 0.8	66.4 ± 21.1
	Megathura crenulata	0.8 ± 0.6	30.3 ± 6.8	1.1 ± 0.6	16.1 ± 4.3
	Muricea californica	12.2 ± 6.3	2.5 ± 1.7	6.4 ± 3.6	8.3 ± 8.0
	Panulirus interruptus	1.1 ± 0.7	0.8 ± 0.6	1.7 ± 1.7	1.1 ± 0.8
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	0	2.8 ± 1.5	0.3 ± 0.3	6.4 ± 2.6
	Pisaster brevispinus	0	0	0	0
	Pisaster giganteus	0.8 ± 0.6	0.8 ± 0.6	2.5 ± 1.6	0.8 ± 0.6
	Pisaster ochraceus	0	0	0	0
	Pycnopodia helianthoides	0	0	0	0
	Strongylocentrotus franciscanus	4.4 ± 2.1	10.6 ± 4.3	12.8 ± 4.7	13.6 ± 7.2
	Strongylocentrotus purpuratus	0	9.7 ± 3.9	1.1 ± 0.6	18.6 ± 6.5
	Styela montereyensis	0	0	0	0
	Tethya californiana	0	0	0	0

Table F.10. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Crystal Cove SMCA in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	0	—
	Eisenia arborea	7.8 ± 4.7	—	15.8 ± 7.6	—
	Laminaria farlowii	21.9 ± 13.2	—	24.4 ± 9.5	—
	Macrocystis pyrifera	14.4 ± 3.2	—	21.7 ± 2.4	—
	Pelagophycus porra	0	—	0	—
	Pterygophora californica	0.8 ± 0.8	—	0	—
Invertebrates	*Centrostephanus coronatus*	0.3 ± 0.3	—	0.3 ± 0.3	—
	Haliotis corrugata	0	—	0.3 ± 0.3	—
	Haliotis fulgens	0	—	0.6 ± 0.4	—
	Haliotis rufescens	0	—	0	—
	Kelletia kelletii	1.1 ± 0.6	—	0.3 ± 0.3	—
	Megastraea undosa	12.5 ± 7.8	—	31.7 ± 11.1	—
	Megathura crenulata	5.0 ± 1.6	—	6.1 ± 3.2	—
	Muricea californica	50.8 ± 19.4	—	21.4 ± 10.4	—
	Panulirus interruptus	2.2 ± 1.6	—	0	—
	Parastichopus californicus	0	—	0	—
	Parastichopus parvimensis	1.7 ± 0.9	—	1.4 ± 0.8	—
	Pisaster brevispinus	0	—	0	—
	Pisaster giganteus	6.1 ± 3.4	—	6.1 ± 3.4	—
	Pisaster ochraceus	0.3 ± 0.3	—	0.3 ± 0.3	—
	Pycnopodia helianthoides	0	—	0	—
	Strongylocentrotus franciscanus	25.3 ± 4.9	—	25.8 ± 6.1	—
	Strongylocentrotus purpuratus	5.8 ± 3.2	—	13.6 ± 6.4	—
	Styela montereyensis	0.6 ± 0.4	—	0	—
	Tethya californiana	0.3 ± 0.3	—	0.6 ± 0.6	—

Table F.11. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Dana Point SMCA in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	0	—
	Eisenia arborea	0	—	5.8 ± 5.8	—
	Laminaria farlowii	0	—	4.7 ± 3.1	—
	Macrocystis pyrifera	16.2 ± 7.0	—	22.2 ± 7.1	—
	Pelagophycus porra	0	—	0	—
	Pterygophora californica	41.7 ± 33.9	—	27.2 ± 17.4	—
Invertebrates	*Centrostephanus coronatus*	0	—	0	—
	Haliotis corrugata	0	—	0	—
	Haliotis fulgens	0	—	0	—
	Haliotis rufescens	0	—	0	—
	Kelletia kelletii	0.8 ± 0.8	—	0	—
	Megastraea undosa	0	—	0.3 ± 0.3	—
	Megathura crenulata	0.4 ± 0.4	—	1.4 ± 0.7	—
	Muricea californica	18.3 ± 11.9	—	26.9 ± 12.9	—
	Panulirus interruptus	0	—	4.7 ± 2.6	—
	Parastichopus californicus	0	—	0	—
	Parastichopus parvimensis	0	—	0	—
	Pisaster brevispinus	0	—	0	—
	Pisaster giganteus	1.2 ± 0.8	—	2.2 ± 0.9	—
	Pisaster ochraceus	0	—	0	—
	Pycnopodia helianthoides	0	—	0	—
	Strongylocentrotus franciscanus	12.5 ± 7.2	—	3.9 ± 2.0	—
	Strongylocentrotus purpuratus	4.6 ± 3.6	—	11.1 ± 5.2	—
	Styela montereyensis	0	—	0.3 ± 0.3	—
	Tethya californiana	2.1 ± 1.6	—	1.9 ± 1.4	—

Table F.12. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Farnsworth Onshore SMCA and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	23.6 ± 7.8	46.1 ± 18.4	58.1 ± 25.6	33.3 ± 18.6
	Laminaria farlowii	67.5 ± 17.8	45.3 ± 19.6	170.0 ± 47.0	53.1 ± 17.4
	Macrocystis pyrifera	33.6 ± 9.6	35.0 ± 6.2	18.6 ± 4.0	27.8 ± 5.7
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	0	0	0
Invertebrates	*Centrostephanus coronatus*	1.9 ± 1.1	19.7 ± 6.8	1.4 ± 1.1	10.8 ± 3.8
	Haliotis corrugata	0.6 ± 0.6	0.8 ± 0.6	0.3 ± 0.3	0.6 ± 0.6
	Haliotis fulgens	0	0	0.6 ± 0.4	4.2 ± 4.2
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	3.6 ± 3.0	1.1 ± 0.7	1.1 ± 0.8	1.1 ± 0.8
	Megastraea undosa	10.8 ± 2.0	2.5 ± 0.9	10.6 ± 3.6	4.7 ± 2.0
	Megathura crenulata	13.3 ± 4.4	3.6 ± 0.9	4.4 ± 1.9	2.2 ± 0.7
	Muricea californica	9.2 ± 3.8	0.8 ± 0.6	4.4 ± 2.9	8.1 ± 5.3
	Panulirus interruptus	3.9 ± 0.9	18.9 ± 3.8	1.7 ± 0.7	6.7 ± 2.1
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	2.5 ± 2.2	0.3 ± 0.3	2.5 ± 1.6	0
	Pisaster brevispinus	0	0	0	0
	Pisaster giganteus	0.8 ± 0.4	1.1 ± 0.7	0.3 ± 0.3	1.7 ± 0.9
	Pisaster ochraceus	0	0	0	0
	Pycnopodia helianthoides	0	0	0	0
	Strongylocentrotus franciscanus	41.1 ± 9.1	12.5 ± 2.8	24.4 ± 12.2	9.2 ± 1.9
	Strongylocentrotus purpuratus	20.6 ± 3.7	5.0 ± 2.9	13.3 ± 5.1	3.3 ± 1.7
	Styela montereyensis	0	0	0	0
	Tethya californiana	0.3 ± 0.3	0	0	0

Table F.13. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Gull Island SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	11.4 ± 5.2	0.1 ± 0.1	13.6 ± 9.2	0
	Eisenia arborea	150.1 ± 41.8	0.7 ± 0.4	101.7 ± 43.8	2.4 ± 1.3
	Laminaria farlowii	68.2 ± 59.1	9.7 ± 4.5	96.0 ± 63.8	23.2 ± 12.7
	Macrocystis pyrifera	17.6 ± 7.1	13.3 ± 4.2	16.0 ± 4.7	28.9 ± 8.7
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	3.9 ± 2.8	155.1 ± 53.5	1.0 ± 0.6	130.9 ± 36.6
Invertebrates	*Centrostephanus coronatus*	0.6 ± 0.2	0.3 ± 0.2	0	0.1 ± 0.1
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	0	0	0.1 ± 0.1
	Kelletia kelletii	0.1 ± 0.1	6.1 ± 2.1	0.3 ± 0.2	4.8 ± 2.0
	Megastraea undosa	4.7 ± 3.0	7.5 ± 1.8	1.5 ± 0.6	13.2 ± 3.3
	Megathura crenulata	4.3 ± 1.7	4.9 ± 1.6	4.9 ± 2.7	2.2 ± 0.9
	Muricea californica	0	6.1 ± 1.8	0	1.5 ± 0.6
	Panulirus interruptus	1.0 ± 0.4	0.3 ± 0.2	1.1 ± 0.5	0.4 ± 0.3
	Parastichopus californicus	0.4 ± 0.4	0	0.8 ± 0.5	0
	Parastichopus parvimensis	11.7 ± 3.8	4.6 ± 1.1	8.6 ± 4.0	4.3 ± 1.0
	Pisaster brevispinus	0	0.4 ± 0.2	0	0.1 ± 0.1
	Pisaster giganteus	16.2 ± 4.1	15.0 ± 2.9	12.9 ± 3.6	12.2 ± 2.3
	Pisaster ochraceus	0	0.3 ± 0.2	0.3 ± 0.2	0.3 ± 0.2
	Pycnopodia helianthoides	0.8 ± 0.5	1.0 ± 0.3	0.7 ± 0.5	1.2 ± 0.4
	Strongylocentrotus franciscanus	362.8 ± 158.3	255.4 ± 61.8	341.8 ± 81.5	210.3 ± 48.7
	Strongylocentrotus purpuratus	1485.1 ± 515.3	445.3 ± 121.0	878.3 ± 172.4	299.2 ± 72.2
	Styela montereyensis	1.1 ± 0.7	0.2 ± 0.1	0.1 ± 0.1	0
	Tethya californiana	13.1 ± 5.7	19.6 ± 5.2	5.6 ± 2.1	14.3 ± 4.4

Table F.14. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Harris Point SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	1.5 ± 1.4	23.8 ± 9.9	1.0 ± 0.7	23.3 ± 9.0
	Laminaria farlowii	0	30.4 ± 13.1	0	46.5 ± 15.6
	Macrocystis pyrifera	0.4 ± 0.3	22.6 ± 3.2	16.4 ± 7.2	36.5 ± 5.0
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	87.4 ± 31.2	1.4 ± 1.0	99.9 ± 46.5
Invertebrates	*Centrostephanus coronatus*	0	0	0	0
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	9.7 ± 2.9	0	9.2 ± 3.1
	Kelletia kelletii	2.8 ± 1.3	5.6 ± 1.6	2.4 ± 0.9	5.0 ± 1.7
	Megastraea undosa	0	0.1 ± 0.1	0	0
	Megathura crenulata	3.5 ± 1.7	0.2 ± 0.1	3.5 ± 2.4	0.6 ± 0.2
	Muricea californica	0	0	0	0
	Panulirus interruptus	0.1 ± 0.1	0	0	0
	Parastichopus californicus	0	0	0.4 ± 0.2	0.4 ± 0.2
	Parastichopus parvimensis	2.5 ± 1.1	0.8 ± 0.4	4.7 ± 1.7	1.2 ± 0.3
	Pisaster brevispinus	0	0.3 ± 0.1	0	0.2 ± 0.1
	Pisaster giganteus	32.8 ± 8.5	14.8 ± 2.7	32.2 ± 5.1	21.9 ± 4.3
	Pisaster ochraceus	0	0	0	0
	Pycnopodia helianthoides	21.5 ± 2.8	4.5 ± 0.8	13.5 ± 2.3	5.1 ± 1.0
	Strongylocentrotus franciscanus	1024.9 ± 174.4	136.7 ± 45.5	918.3 ± 197.6	117.6 ± 35.7
	Strongylocentrotus purpuratus	2.2 ± 1.2	25.4 ± 12.1	2.9 ± 2.3	17.8 ± 8.4
	Styela montereyensis	0	3.0 ± 0.5	0.1 ± 0.1	5.9 ± 1.2
	Tethya californiana	20.8 ± 6.4	16.7 ± 3.0	24.4 ± 7.6	15.8 ± 3.2

Table F.16. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Laguna Beach SMR in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	0	—
	Eisenia arborea	11.9 ± 6.8	—	12.8 ± 8.0	—
	Laminaria farlowii	0	—	0	—
	Macrocystis pyrifera	17.2 ± 3.2	—	45.3 ± 22.9	—
	Pelagophycus porra	0	—	0	—
	Pterygophora californica	35.3 ± 23.8	—	16.4 ± 7.2	—
Invertebrates	*Centrostephanus coronatus*	0.3 ± 0.3	—	0	—
	Haliotis corrugata	0	—	0.3 ± 0.3	—
	Haliotis fulgens	0	—	0	—
	Haliotis rufescens	0	—	0	—
	Kelletia kelletii	2.5 ± 2.2	—	0.6 ± 0.4	—
	Megastraea undosa	2.8 ± 1.1	—	25.6 ± 13.7	—
	Megathura crenulata	1.4 ± 0.7	—	2.2 ± 1.1	—
	Muricea californica	16.4 ± 7.0	—	13.9 ± 6.9	—
	Panulirus interruptus	0	—	0.3 ± 0.3	—
	Parastichopus californicus	0	—	0	—
	Parastichopus parvimensis	0.6 ± 0.4	—	15.6 ± 11.4	—
	Pisaster brevispinus	0	—	0	—
	Pisaster giganteus	4.4 ± 2.1	—	3.6 ± 1.6	—
	Pisaster ochraceus	0	—	0	—
	Pycnopodia helianthoides	0	—	0	—
	Strongylocentrotus franciscanus	16.4 ± 10.9	—	103.3 ± 48.7	—
	Strongylocentrotus purpuratus	1.1 ± 0.8	—	51.4 ± 12.9	—
	Styela montereyensis	0.6 ± 0.4	—	0	—
	Tethya californiana	1.4 ± 1.1	—	3.1 ± 2.7	—

Table F.17. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Long Point SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	5.0 ± 4.1	53.3 ± 30.6	0.6 ± 0.6	26.1 ± 15.7
	Laminaria farlowii	4.2 ± 2.3	1.9 ± 1.6	13.3 ± 10.7	9.2 ± 7.9
	Macrocystis pyrifera	35.6 ± 12.3	36.7 ± 14.0	25.0 ± 7.3	26.9 ± 7.6
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	0	0	0
Invertebrates	*Centrostephanus coronatus*	46.9 ± 20.6	55.3 ± 27.4	16.1 ± 6.3	36.4 ± 16.0
	Haliotis corrugata	0	0.3 ± 0.3	0	0.3 ± 0.3
	Haliotis fulgens	0	1.4 ± 1.1	0.8 ± 0.6	0.8 ± 0.6
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	0.8 ± 0.8	0.3 ± 0.3	0.6 ± 0.6	0.3 ± 0.3
	Megastraea undosa	0.6 ± 0.6	0.8 ± 0.8	31.9 ± 14.9	3.3 ± 1.6
	Megathura crenulata	0	0.3 ± 0.3	0	0.3 ± 0.3
	Muricea californica	0.6 ± 0.4	6.7 ± 3.0	1.4 ± 0.8	13.9 ± 6.3
	Panulirus interruptus	1.9 ± 1.6	2.5 ± 0.8	2.2 ± 1.5	6.7 ± 3.1
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	0.8 ± 0.8	0.6 ± 0.6	0	0
	Pisaster brevispinus	0	0	0	0
	Pisaster giganteus	1.7 ± 0.9	2.2 ± 1.5	0	1.7 ± 1.1
	Pisaster ochraceus	0	0	0	0
	Pycnopodia helianthoides	0	0	0	0
	Strongylocentrotus franciscanus	0	0.8 ± 0.6	2.2 ± 1.4	0
	Strongylocentrotus purpuratus	0	0	0.3 ± 0.3	0
	Styela montereyensis	0	0	0	0
	Tethya californiana	0	0	0	0

Table F.18. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Lover's Cove SMCA in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	0	—
	Eisenia arborea	3.3 ± 1.8	—	1.9 ± 0.9	—
	Laminaria farlowii	5.6 ± 3.7	—	1.1 ± 0.7	—
	Macrocystis pyrifera	37.5 ± 6.7	—	30.3 ± 7.6	—
	Pelagophycus porra	0.3 ± 0.3	—	0	—
	Pterygophora californica	0	—	0	—
Invertebrates	*Centrostephanus coronatus*	28.1 ± 11.3	—	9.4 ± 4.6	—
	Haliotis corrugata	0.6 ± 0.6	—	0	—
	Haliotis fulgens	1.9 ± 1.2	—	1.4 ± 1.1	—
	Haliotis rufescens	0	—	0	—
	Kelletia kelletii	3.3 ± 2.0	—	0	—
	Megastraea undosa	18.9 ± 5.9	—	11.1 ± 5.4	—
	Megathura crenulata	0	—	0	—
	Muricea californica	3.3 ± 1.4	—	13.3 ± 6.3	—
	Panulirus interruptus	8.3 ± 5.4	—	6.4 ± 5.5	—
	Parastichopus californicus	0	—	1.4 ± 1.4	—
	Parastichopus parvimensis	10.8 ± 3.2	—	0.3 ± 0.3	—
	Pisaster brevispinus	0	—	0	—
	Pisaster giganteus	0.6 ± 0.4	—	0.3 ± 0.3	—
	Pisaster ochraceus	0	—	0	—
	Pycnopodia helianthoides	0	—	0	—
	Strongylocentrotus franciscanus	3.1 ± 1.5	—	0	—
	Strongylocentrotus purpuratus	2.5 ± 1.9	—	0.3 ± 0.3	—
	Styela montereyensis	0	—	0	—
	Tethya californiana	0	—	0	—

Table F.19. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Matlahuayl SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	65.8 ± 24.7	34.2 ± 11.2	23.3 ± 11.4	19.7 ± 8.8
	Laminaria farlowii	17.9 ± 14.3	20.6 ± 10.2	13.3 ± 8.7	23.1 ± 15.4
	Macrocystis pyrifera	5.8 ± 2.0	2.8 ± 0.9	5.8 ± 2.8	6.4 ± 4.0
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	11.4 ± 6.9	3.3 ± 3.3	18.1 ± 13.3
Invertebrates	*Centrostephanus coronatus*	0	0	0	0
	Haliotis corrugata	0	0.8 ± 0.8	0.4 ± 0.4	0
	Haliotis fulgens	0	0	0.4 ± 0.4	2.2 ± 2.2
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	2.1 ± 1.2	0.6 ± 0.4	0.4 ± 0.4	0
	Megastraea undosa	0	2.2 ± 1.3	0.4 ± 0.4	1.1 ± 0.7
	Megathura crenulata	0.8 ± 0.5	1.9 ± 1.1	1.7 ± 1.7	3.1 ± 1.6
	Muricea californica	0.4 ± 0.4	1.1 ± 1.1	1.7 ± 1.2	1.4 ± 1.4
	Panulirus interruptus	3.8 ± 1.7	4.7 ± 3.2	10.8 ± 4.2	3.9 ± 2.0
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	0	0.3 ± 0.3	0	0
	Pisaster brevispinus	0	0	0	0
	Pisaster giganteus	0	0.6 ± 0.4	1.7 ± 1.0	0.6 ± 0.4
	Pisaster ochraceus	0	0	0	0
	Pycnopodia helianthoides	0	0	0	0
	Strongylocentrotus franciscanus	10.8 ± 7.9	0.3 ± 0.3	19.2 ± 13.8	7.2 ± 4.7
	Strongylocentrotus purpuratus	0	0	2.5 ± 2.5	3.6 ± 2.4
	Styela montereyensis	0	0	0	0
	Tethya californiana	0.4 ± 0.4	0	0	0.3 ± 0.3

Table F.20. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Naples SMCA and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	0	0	0	0
	Laminaria farlowii	8.5 ± 3.1	0	22.4 ± 8.9	0
	Macrocystis pyrifera	3.5 ± 2.0	5.8 ± 3.5	2.4 ± 1.2	15.0 ± 5.9
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	469.3 ± 150.6	185.7 ± 117.7	221.4 ± 48.9	201.0 ± 127.1
Invertebrates	*Centrostephanus coronatus*	0.1 ± 0.1	0	0.7 ± 0.5	0
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0.6 ± 0.3	0	0.3 ± 0.2	0
	Kelletia kelletii	25.8 ± 5.3	5.4 ± 3.0	15.3 ± 5.5	7.8 ± 2.6
	Megastraea undosa	0.3 ± 0.2	0.1 ± 0.1	0.1 ± 0.1	0
	Megathura crenulata	10.0 ± 5.7	0	6.9 ± 3.0	1.2 ± 0.5
	Muricea californica	1.4 ± 0.7	0.4 ± 0.3	0.7 ± 0.3	1.0 ± 0.8
	Panulirus interruptus	0	0	0.1 ± 0.1	0
	Parastichopus californicus	0	0	0.3 ± 0.3	0.1 ± 0.1
	Parastichopus parvimensis	5.3 ± 1.5	4.0 ± 0.9	1.7 ± 0.7	5.3 ± 2.7
	Pisaster brevispinus	0.6 ± 0.3	1.7 ± 0.8	0.8 ± 0.4	2.1 ± 1.3
	Pisaster giganteus	35.4 ± 7.9	13.1 ± 4.4	31.2 ± 6.1	18.2 ± 4.6
	Pisaster ochraceus	0	0.4 ± 0.3	0	0.3 ± 0.2
	Pycnopodia helianthoides	4.7 ± 1.3	1.2 ± 0.4	3.9 ± 0.9	1.9 ± 0.9
	Strongylocentrotus franciscanus	329.0 ± 76.8	33.6 ± 8.2	290.1 ± 72.4	137.9 ± 68.4
	Strongylocentrotus purpuratus	364.2 ± 128.8	777.2 ± 226.2	215.1 ± 79.8	302.1 ± 181.8
	Styela montereyensis	26.1 ± 9.3	15.7 ± 11.7	24.3 ± 10.0	7.9 ± 4.4
	Tethya californiana	25.4 ± 5.6	3.3 ± 2.5	23.1 ± 4.9	7.4 ± 4.2

Table F.21. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Painted Cave SMCA and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	106.9 ± 42.5	66.6 ± 20.4	72.6 ± 26.3	42.9 ± 17.6
	Laminaria farlowii	0	36.0 ± 17.9	0	26.9 ± 13.8
	Macrocystis pyrifera	0	35.1 ± 12.3	0	35.3 ± 9.6
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	0.8 ± 0.6	0	0.1 ± 0.1
Invertebrates	*Centrostephanus coronatus*	0.3 ± 0.2	0	0.1 ± 0.1	0
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	0.4 ± 0.2	0	0.2 ± 0.2
	Kelletia kelletii	0	2.6 ± 1.1	0	1.2 ± 0.5
	Megastraea undosa	0.3 ± 0.3	0.8 ± 0.2	0	1.3 ± 0.7
	Megathura crenulata	4.6 ± 1.8	2.5 ± 1.2	2.5 ± 1.0	1.7 ± 0.7
	Muricea californica	0	0.5 ± 0.3	0	0.3 ± 0.2
	Panulirus interruptus	0	0	0.1 ± 0.1	0
	Parastichopus californicus	0	0.1 ± 0.1	0	0
	Parastichopus parvimensis	7.6 ± 2.5	4.6 ± 1.0	5.4 ± 2.4	2.2 ± 0.5
	Pisaster brevispinus	0	0	0	0.1 ± 0.1
	Pisaster giganteus	51.0 ± 7.6	24.0 ± 5.3	44.2 ± 15.8	23.2 ± 4.7
	Pisaster ochraceus	7.8 ± 7.2	1.0 ± 0.6	7.1 ± 4.9	0.4 ± 0.3
	Pycnopodia helianthoides	1.2 ± 0.5	5.7 ± 1.8	1.4 ± 0.6	5.8 ± 2.0
	Strongylocentrotus franciscanus	429.7 ± 74.5	328.3 ± 64.2	666.9 ± 174.7	325.7 ± 74.1
	Strongylocentrotus purpuratus	918.3 ± 234.0	1014.0 ± 243.8	1230.6 ± 413.8	834.2 ± 267.7
	Styela montereyensis	1.5 ± 0.9	18.1 ± 5.0	0.3 ± 0.2	6.3 ± 2.1
	Tethya californiana	13.8 ± 4.8	12.3 ± 2.2	7.2 ± 2.3	8.1 ± 1.7

Table F.22. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Point Dume SMCA in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	—	0	—
	Eisenia arborea	0	—	0.8 ± 0.8	—
	Laminaria farlowii	0	—	0	—
	Macrocystis pyrifera	41.7 ± 10.6	—	18.6 ± 6.6	—
	Pelagophycus porra	0	—	0	—
	Pterygophora californica	83.3 ± 50.6	—	6.7 ± 4.2	—
Invertebrates	*Centrostephanus coronatus*	0	—	0	—
	Haliotis corrugata	0	—	0	—
	Haliotis fulgens	0	—	0	—
	Haliotis rufescens	0	—	0	—
	Kelletia kelletii	7.2 ± 6.0	—	3.9 ± 2.7	—
	Megastraea undosa	0	—	0	—
	Megathura crenulata	1.1 ± 0.6	—	2.5 ± 1.3	—
	Muricea californica	57.8 ± 34.4	—	38.6 ± 18.9	—
	Panulirus interruptus	0.3 ± 0.3	—	0	—
	Parastichopus californicus	0	—	0	—
	Parastichopus parvimensis	4.2 ± 2.3	—	3.3 ± 1.2	—
	Pisaster brevispinus	2.2 ± 1.4	—	1.4 ± 0.9	—
	Pisaster giganteus	28.1 ± 9.4	—	39.4 ± 12.9	—
	Pisaster ochraceus	0.3 ± 0.3	—	1.7 ± 0.7	—
	Pycnopodia helianthoides	0	—	0	—
	Strongylocentrotus franciscanus	118.9 ± 73.4	—	219.7 ± 84.2	—
	Strongylocentrotus purpuratus	433.1 ± 162.8	—	588.6 ± 206.5	—
	Styela montereyensis	162.2 ± 63.5	—	49.4 ± 18.8	—
	Tethya californiana	8.3 ± 6.3	—	5.3 ± 4.6	—

Table F.23. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Point Dume SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	33.9 ± 16.3	0	3.9 ± 1.9	0
	Laminaria farlowii	12.2 ± 5.6	0	4.4 ± 2.8	0
	Macrocystis pyrifera	20.6 ± 6.2	11.4 ± 3.9	8.9 ± 3.0	22.2 ± 3.7
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	277.4 ± 103.3	21.4 ± 13.6	278.5 ± 116.3	24.7 ± 22.2
Invertebrates	*Centrostephanus coronatus*	1.0 ± 0.6	1.4 ± 1.1	0.6 ± 0.4	1.4 ± 0.9
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	6.0 ± 2.3	21.1 ± 9.8	9.4 ± 4.8	15.0 ± 4.9
	Megastraea undosa	0.7 ± 0.3	0	2.2 ± 1.1	0.3 ± 0.3
	Megathura crenulata	6.7 ± 3.2	2.8 ± 1.5	16.7 ± 12.1	7.2 ± 3.4
	Muricea californica	66.1 ± 33.3	49.2 ± 15.6	69.0 ± 27.3	30.0 ± 10.9
	Panulirus interruptus	1.1 ± 0.6	0	1.9 ± 0.7	0
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	2.2 ± 0.9	7.8 ± 5.8	3.3 ± 1.4	7.2 ± 3.1
	Pisaster brevispinus	0.6 ± 0.4	0	0.6 ± 0.3	0
	Pisaster giganteus	23.3 ± 3.7	30.6 ± 8.7	22.8 ± 7.3	25.8 ± 3.9
	Pisaster ochraceus	13.5 ± 6.8	0	8.9 ± 4.3	0
	Pycnopodia helianthoides	0.4 ± 0.3	0	0	0
	Strongylocentrotus franciscanus	101.7 ± 34.6	170.0 ± 47.5	199.2 ± 79.1	202.8 ± 65.2
	Strongylocentrotus purpuratus	773.8 ± 324.6	113.9 ± 50.7	715.6 ± 300.0	163.1 ± 77.3
	Styela montereyensis	51.0 ± 17.4	19.4 ± 10.8	19.0 ± 6.2	11.9 ± 3.0
	Tethya californiana	1.2 ± 0.9	17.5 ± 6.5	0.8 ± 0.7	27.2 ± 8.2

Table F.24. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Point Vicente SMCA and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	105.9 ± 35.9	0	96.4 ± 26.6
	Eisenia arborea	60.1 ± 25.8	9.8 ± 5.1	80.1 ± 22.3	4.2 ± 1.7
	Laminaria farlowii	0	0	0.1 ± 0.1	2.6 ± 1.8
	Macrocystis pyrifera	65.8 ± 24.5	29.7 ± 7.4	31.0 ± 7.5	19.7 ± 6.5
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	1.9 ± 0.8	102.2 ± 34.7	6.6 ± 2.1	76.5 ± 20.0
Invertebrates	*Centrostephanus coronatus*	0.1 ± 0.1	0.1 ± 0.1	0	0.2 ± 0.1
	Haliotis corrugata	0	0.1 ± 0.1	0.1 ± 0.1	0.2 ± 0.1
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	5.2 ± 1.2	6.7 ± 1.3	2.6 ± 1.1	4.2 ± 0.7
	Megastraea undosa	0.4 ± 0.2	8.2 ± 1.9	0.9 ± 0.6	5.9 ± 1.3
	Megathura crenulata	8.0 ± 2.7	1.3 ± 0.4	3.6 ± 1.4	1.5 ± 0.3
	Muricea californica	14.1 ± 5.3	2.2 ± 1.0	9.9 ± 4.3	0.5 ± 0.3
	Panulirus interruptus	0.5 ± 0.3	0.2 ± 0.1	0.1 ± 0.1	0.5 ± 0.2
	Parastichopus californicus	2.2 ± 1.1	0	1.8 ± 0.8	0
	Parastichopus parvimensis	0.6 ± 0.3	0.9 ± 0.4	0.5 ± 0.3	1.3 ± 0.3
	Pisaster brevispinus	0	0	0.2 ± 0.1	0
	Pisaster giganteus	14.0 ± 2.3	7.2 ± 1.4	11.7 ± 1.7	5.4 ± 1.0
	Pisaster ochraceus	6.6 ± 2.6	0.2 ± 0.2	4.1 ± 1.4	0.1 ± 0.1
	Pycnopodia helianthoides	0.7 ± 0.4	0	0.2 ± 0.1	0
	Strongylocentrotus franciscanus	16.5 ± 3.9	21.0 ± 3.4	34.5 ± 10.7	22.5 ± 4.3
	Strongylocentrotus purpuratus	73.6 ± 24.4	16.1 ± 3.6	104.6 ± 52.7	36.0 ± 8.5
	Styela montereyensis	1.0 ± 0.4	0	1.0 ± 0.3	0
	Tethya californiana	19.2 ± 7.0	2.4 ± 0.7	14.4 ± 4.2	3.7 ± 1.2

Table F.25. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Santa Barbara Island SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0.5 ± 0.5	0
	Eisenia arborea	3.9 ± 2.6	43.5 ± 22.1	30.1 ± 17.4	82.2 ± 31.5
	Laminaria farlowii	0	38.8 ± 22.9	0.1 ± 0.1	10.6 ± 6.3
	Macrocystis pyrifera	39.7 ± 13.9	5.7 ± 3.2	29.5 ± 7.0	1.4 ± 0.9
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	0	0	0
Invertebrates	*Centrostephanus coronatus*	1.5 ± 0.8	8.1 ± 5.5	5.8 ± 3.3	1.1 ± 0.7
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	0	0	0.1 ± 0.1	0
	Megastraea undosa	3.1 ± 1.5	2.6 ± 1.4	2.6 ± 0.9	0
	Megathura crenulata	0	3.2 ± 0.8	0.6 ± 0.3	1.1 ± 0.6
	Muricea californica	1.2 ± 0.5	0.7 ± 0.5	2.0 ± 0.9	0.3 ± 0.3
	Panulirus interruptus	1.1 ± 0.8	0	1.2 ± 0.5	0
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	4.6 ± 1.5	0.7 ± 0.3	7.5 ± 2.7	4.2 ± 1.9
	Pisaster brevispinus	0	0	0	0
	Pisaster giganteus	3.3 ± 1.1	14.9 ± 3.9	2.0 ± 0.8	13.9 ± 5.6
	Pisaster ochraceus	0.4 ± 0.2	8.0 ± 4.8	0	3.1 ± 2.2
	Pycnopodia helianthoides	0.1 ± 0.1	0	0	0
	Strongylocentrotus franciscanus	277.5 ± 101.1	510.4 ± 130.0	116.9 ± 26.3	228.6 ± 69.2
	Strongylocentrotus purpuratus	782.9 ± 291.8	1654.5 ± 470.1	163.2 ± 44.2	57.8 ± 31.7
	Styela montereyensis	0	0	0	0
	Tethya californiana	3.8 ± 3.0	0.6 ± 0.3	1.1 ± 0.6	0

Table F.26. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Scorpion SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	59.2 ± 27.1	13.5 ± 7.9	47.4 ± 14.3	0.5 ± 0.3
	Laminaria farlowii	0.3 ± 0.3	13.6 ± 8.2	0.3 ± 0.2	0.3 ± 0.2
	Macrocystis pyrifera	26.8 ± 7.8	7.6 ± 2.5	23.3 ± 7.4	1.0 ± 1.0
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	0	0.4 ± 0.4	0
Invertebrates	*Centrostephanus coronatus*	0.8 ± 0.3	0.5 ± 0.2	0.3 ± 0.1	0.1 ± 0.1
	Haliotis corrugata	0	0	0	0.1 ± 0.1
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	0.6 ± 0.4	0.5 ± 0.2	1.1 ± 0.7	2.6 ± 0.9
	Megastraea undosa	3.5 ± 2.2	0.9 ± 0.5	4.9 ± 2.8	3.1 ± 2.5
	Megathura crenulata	16.7 ± 3.5	23.6 ± 4.2	14.0 ± 4.2	18.5 ± 3.6
	Muricea californica	0.2 ± 0.2	1.3 ± 0.8	0.3 ± 0.1	1.5 ± 1.3
	Panulirus interruptus	2.0 ± 0.6	0.1 ± 0.1	1.1 ± 0.3	0.1 ± 0.1
	Parastichopus californicus	0	0.6 ± 0.3	0.1 ± 0.1	0.1 ± 0.1
	Parastichopus parvimensis	66.9 ± 12.1	19.2 ± 2.6	83.7 ± 13.5	14.5 ± 2.7
	Pisaster brevispinus	0	0	0	0
	Pisaster giganteus	16.9 ± 2.5	31.8 ± 5.4	23.2 ± 5.3	30.9 ± 4.6
	Pisaster ochraceus	6.0 ± 2.2	4.2 ± 1.5	5.2 ± 2.5	4.4 ± 1.8
	Pycnopodia helianthoides	0.1 ± 0.1	1.7 ± 0.4	0.1 ± 0.1	1.7 ± 0.6
	Strongylocentrotus franciscanus	353.5 ± 54.0	215.9 ± 29.6	409.2 ± 64.2	266.0 ± 32.5
	Strongylocentrotus purpuratus	1120.4 ± 260.4	1688.9 ± 550.4	1351.8 ± 217.4	1082.9 ± 174.3
	Styela montereyensis	0.1 ± 0.1	0.3 ± 0.2	0	0.1 ± 0.1
	Tethya californiana	14.1 ± 3.4	10.0 ± 2.4	13.2 ± 3.4	8.7 ± 3.2

Table F.27. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at South La Jolla SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	8.3 ± 7.6	5.2 ± 3.4
	Eisenia arborea	9.6 ± 5.7	0	1.5 ± 0.9	2.9 ± 1.6
	Laminaria farlowii	26.9 ± 11.7	36.9 ± 12.8	17.5 ± 11.5	30.4 ± 13.7
	Macrocystis pyrifera	7.7 ± 2.4	16.5 ± 10.1	5.8 ± 2.9	10.6 ± 5.1
	Pelagophycus porra	0	3.1 ± 2.9	11.0 ± 7.4	10.2 ± 6.7
	Pterygophora californica	20.4 ± 11.0	42.1 ± 14.7	21.0 ± 13.5	32.7 ± 16.8
Invertebrates	*Centrostephanus coronatus*	0	0	0.2 ± 0.2	0
	Haliotis corrugata	0	0	0	0.4 ± 0.4
	Haliotis fulgens	0	0	0	0.2 ± 0.2
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	1.5 ± 0.7	1.2 ± 1.0	0.4 ± 0.4	0
	Megastraea undosa	1.0 ± 0.6	5.6 ± 4.6	2.7 ± 1.0	1.9 ± 0.6
	Megathura crenulata	1.5 ± 0.6	0.2 ± 0.2	1.0 ± 0.6	0.6 ± 0.4
	Muricea californica	0	0	0.6 ± 0.4	0
	Panulirus interruptus	1.7 ± 0.9	4.0 ± 3.1	1.5 ± 0.4	2.3 ± 1.6
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	0.2 ± 0.2	0	0.8 ± 0.6	0
	Pisaster brevispinus	0	0.2 ± 0.2	0	0
	Pisaster giganteus	1.2 ± 0.5	1.7 ± 0.7	4.0 ± 1.3	4.8 ± 2.3
	Pisaster ochraceus	0	0	0	0
	Pycnopodia helianthoides	0	0	0	0
	Strongylocentrotus franciscanus	0.8 ± 0.6	1.7 ± 0.9	9.2 ± 5.3	4.0 ± 2.8
	Strongylocentrotus purpuratus	1.0 ± 1.0	1.9 ± 1.9	0.2 ± 0.2	4.8 ± 3.3
	Styela montereyensis	0	0	0	0
	Tethya californiana	2.5 ± 1.3	3.5 ± 2.2	1.9 ± 0.9	1.5 ± 0.9

Table F.28. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at South Point SMR and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	13.3 ± 6.1	5.3 ± 2.2	7.4 ± 4.7	3.3 ± 1.0
	Laminaria farlowii	43.3 ± 24.6	32.1 ± 7.7	37.1 ± 33.0	30.9 ± 7.4
	Macrocystis pyrifera	13.2 ± 1.3	19.8 ± 2.7	30.7 ± 5.7	25.1 ± 3.5
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	133.2 ± 33.6	199.6 ± 50.6	153.2 ± 35.7	152.0 ± 46.4
Invertebrates	*Centrostephanus coronatus*	0	0	0	0
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0	0	0	0
	Haliotis rufescens	2.9 ± 1.2	0.3 ± 0.2	1.8 ± 0.8	0.3 ± 0.2
	Kelletia kelletii	1.2 ± 0.7	4.4 ± 1.5	0.3 ± 0.3	3.0 ± 1.2
	Megastraea undosa	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1
	Megathura crenulata	0.6 ± 0.3	0.3 ± 0.2	0.7 ± 0.2	0.2 ± 0.2
	Muricea californica	0	0	0	0.1 ± 0.1
	Panulirus interruptus	0.3 ± 0.3	0.1 ± 0.1	0	0
	Parastichopus californicus	0	0.2 ± 0.2	0	0.2 ± 0.2
	Parastichopus parvimensis	1.4 ± 0.5	1.2 ± 0.5	1.9 ± 0.9	1.9 ± 0.9
	Pisaster brevispinus	0	0.1 ± 0.1	0	0
	Pisaster giganteus	13.1 ± 4.0	8.2 ± 1.6	11.0 ± 2.2	10.2 ± 2.5
	Pisaster ochraceus	0.1 ± 0.1	0	0	0
	Pycnopodia helianthoides	1.5 ± 0.8	5.0 ± 1.1	0.3 ± 0.2	3.7 ± 0.7
	Strongylocentrotus franciscanus	227.6 ± 78.3	80.0 ± 23.4	121.7 ± 40.0	83.8 ± 25.9
	Strongylocentrotus purpuratus	646.5 ± 408.9	76.9 ± 17.7	47.1 ± 17.9	12.0 ± 3.5
	Styela montereyensis	73.2 ± 18.3	97.8 ± 14.7	12.8 ± 2.1	24.7 ± 4.7
	Tethya californiana	9.3 ± 1.8	30.7 ± 7.2	9.2 ± 3.2	20.9 ± 4.7

Table F.29. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Swami's SMCA and reference sites in 2011 and 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	0	0	0	0
	Eisenia arborea	23.1 ± 19.8	19.4 ± 12.8	2.8 ± 1.6	15.8 ± 12.3
	Laminaria farlowii	0.6 ± 0.4	0	0.3 ± 0.3	0
	Macrocystis pyrifera	18.9 ± 6.9	17.2 ± 7.0	44.2 ± 22.1	35.0 ± 8.0
	Pelagophycus porra	0	0	0	0
	Pterygophora californica	0	0	0.3 ± 0.3	0
Invertebrates	*Centrostephanus coronatus*	0	0	0	0
	Haliotis corrugata	0	0	0	0
	Haliotis fulgens	0.3 ± 0.3	0	0	0
	Haliotis rufescens	0	0	0	0
	Kelletia kelletii	0.6 ± 0.4	0.6 ± 0.4	5.0 ± 5.0	0.6 ± 0.6
	Megastraea undosa	1.7 ± 1.4	1.4 ± 1.1	3.3 ± 2.7	3.1 ± 2.1
	Megathura crenulata	1.1 ± 0.7	2.2 ± 1.1	3.3 ± 1.4	1.9 ± 0.9
	Muricea californica	2.2 ± 1.6	28.3 ± 17.6	17.5 ± 8.7	36.7 ± 12.2
	Panulirus interruptus	1.1 ± 1.1	2.2 ± 0.6	4.2 ± 2.4	2.2 ± 1.6
	Parastichopus californicus	0	0	0	0
	Parastichopus parvimensis	0	0	0	0
	Pisaster brevispinus	0	0	0	0.6 ± 0.6
	Pisaster giganteus	4.2 ± 1.7	1.4 ± 0.7	2.5 ± 1.6	2.2 ± 0.8
	Pisaster ochraceus	0	0	0	0
	Pycnopodia helianthoides	0	0	0	0
	Strongylocentrotus franciscanus	0	6.1 ± 3.9	10.6 ± 7.1	7.8 ± 3.9
	Strongylocentrotus purpuratus	0.8 ± 0.8	2.2 ± 1.2	2.5 ± 1.2	1.7 ± 1.7
	Styela montereyensis	0.3 ± 0.3	0.3 ± 0.3	0	0
	Tethya californiana	0.3 ± 0.3	0	4.2 ± 2.9	1.7 ± 1.4

Table F.30. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at SWAT 1 and reference sites in 2012.

	Kelps and benthic macroinvertebrates	**2011**		**2012**	
		MPA	**Reference**	**MPA**	**Reference**
Kelps	*Agarum fimbriatum*	—	—	3.1 ± 1.9	1.0 ± 0.8
	Eisenia arborea	—	—	133.9 ± 58.5	36.7 ± 16.9
	Laminaria farlowii	—	—	39.7 ± 23.5	152.9 ± 72.5
	Macrocystis pyrifera	—	—	21.1 ± 4.5	20.8 ± 5.2
	Pelagophycus porra	—	—	0.8 ± 0.6	0
	Pterygophora californica	—	—	0.3 ± 0.3	0.8 ± 0.8
Invertebrates	*Centrostephanus coronatus*	—	—	1.1 ± 0.6	1.5 ± 1.2
	Haliotis corrugata	—	—	0	0.2 ± 0.2
	Haliotis fulgens	—	—	0	0.2 ± 0.2
	Haliotis rufescens	—	—	0	0
	Kelletia kelletii	—	—	0	0.2 ± 0.2
	Megastraea undosa	—	—	0.3 ± 0.3	0.8 ± 0.4
	Megathura crenulata	—	—	0.6 ± 0.4	2.1 ± 0.6
	Muricea californica	—	—	45.8 ± 15.2	12.3 ± 7.4
	Panulirus interruptus	—	—	1.1 ± 0.7	3.1 ± 2.1
	Parastichopus californicus	—	—	0	0
	Parastichopus parvimensis	—	—	5.6 ± 2.3	9.0 ± 3.8
	Pisaster brevispinus	—	—	0	0
	Pisaster giganteus	—	—	4.7 ± 1.0	6.0 ± 1.8
	Pisaster ochraceus	—	—	0	0
	Pycnopodia helianthoides	—	—	0	0
	Strongylocentrotus franciscanus	—	—	65.6 ± 14.2	139.4 ± 40.6
	Strongylocentrotus purpuratus	—	—	5.0 ± 2.4	36.2 ± 7.0
	Styela montereyensis	—	—	0	0
	Tethya californiana	—	—	13.9 ± 6.9	3.3 ± 1.3

Table F.31. Mean numerical densities (#/100m^2) (± standard error) of the focal kelp and benthic macroinvertebrate species at Wilson Cove and reference sites in 2012.

	Kelps and benthic macroinvertebrates	2011		2012	
		MPA	Reference	MPA	Reference
Kelps	*Agarum fimbriatum*	—	—	4.4 ± 2.5	0
	Eisenia arborea	—	—	45.6 ± 9.7	51.2 ± 18.2
	Laminaria farlowii	—	—	36.7 ± 15.6	1.0 ± 1.0
	Macrocystis pyrifera	—	—	30.0 ± 6.0	9.8 ± 2.5
	Pelagophycus porra	—	—	0	0
	Pterygophora californica	—	—	0	0
Invertebrates	*Centrostephanus coronatus*	—	—	1.9 ± 0.8	54.0 ± 8.4
	Haliotis corrugata	—	—	1.1 ± 0.6	0.5 ± 0.3
	Haliotis fulgens	—	—	0	0
	Haliotis rufescens	—	—	0	0
	Kelletia kelletii	—	—	0	0
	Megastraea undosa	—	—	5.6 ± 3.3	2.2 ± 0.9
	Megathura crenulata	—	—	0	2.0 ± 1.1
	Muricea californica	—	—	8.6 ± 3.9	2.5 ± 1.0
	Panulirus interruptus	—	—	0.8 ± 0.6	35.2 ± 13.1
	Parastichopus californicus	—	—	0	0
	Parastichopus parvimensis	—	—	9.2 ± 2.1	0
	Pisaster brevispinus	—	—	0	0
	Pisaster giganteus	—	—	0	0.3 ± 0.3
	Pisaster ochraceus	—	—	0	0
	Pycnopodia helianthoides	—	—	0	0
	Strongylocentrotus franciscanus	—	—	22.5 ± 7.4	0.2 ± 0.2
	Strongylocentrotus purpuratus	—	—	5.6 ± 2.6	0.2 ± 0.2
	Styela montereyensis	—	—	0	0
	Tethya californiana	—	—	0	0.2 ± 0.2

Appendix G

Table G.1. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Abalone Cove SMCA and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	2011		2012		2011		2012	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	3.1 ± 1.9	2.6 ± 1.8	0.2 ± 0.2	7.1 ± 4.0	41.5 ± 21.2	24.2 ± 18.0	3.0 ± 3.0	93.4 ± 48.8
Chromis punctipinnis	9.2 ± 4.2	2.5 ± 1.4	0.8 ± 0.6	13.2 ± 6.7	178.7 ± 78.3	101.6 ± 46.8	40.2 ± 30.4	532.4 ± 282.2
Embiotoca jacksoni	6.5 ± 2.3	1.7 ± 0.6	0.4 ± 0.3	2.1 ± 0.8	590.7 ± 246.0	144.0 ± 55.4	64.7 ± 42.4	163.2 ± 81.3
Girella nigricans	1.0 ± 0.4	8.1 ± 4.1	0.2 ± 0.2	8.9 ± 5.2	190.5 ± 113.4	2609.7 ± 1211.9	108.0 ± 108.0	3962.6 ± 2396.8
Hypsypops rubicundus	4.8 ± 1.1	2.1 ± 0.5	2.3 ± 1.0	2.2 ± 0.9	1293.4 ± 349.1	514.6 ± 148.8	562.5 ± 249.1	429.5 ± 200.8
Oxyjulis californica	5.6 ± 1.4	14.0 ± 8.5	1.9 ± 0.9	20.8 ± 12.0	305.4 ± 82.0	601.6 ± 317.3	99.2 ± 48.1	370.0 ± 157.3
Paralabrax clathratus	0.6 ± 0.3	3.6 ± 1.2	0.4 ± 0.3	4.6 ± 1.2	198.1 ± 116.0	734.1 ± 274.1	287.1 ± 192.9	1163.4 ± 333.1
Paralabrax nebulifer	0.2 ± 0.2	0.1 ± 0.1	0.2 ± 0.2	0.0 ± 0.0	77.4 ± 77.4	29.8 ± 29.8	44.8 ± 44.8	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	0.8 ± 0.6	0.3 ± 0.3	1.7 ± 1.2	0.3 ± 0.2	128.9 ± 87.2	67.2 ± 66.5	399.2 ± 292.2	50.8 ± 36.2
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	3.6 ± 3.6	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serriceps	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	1.5 ± 0.9	2.4 ± 0.9	0.4 ± 0.3	1.5 ± 0.6	595.8 ± 369.6	1094.7 ± 475.8	173.3 ± 113.4	1802.6 ± 844.6
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.2. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Anacapa Island SMCA in 2011 and 2012.

	Density				Biomass Density			
Fish Species	2011		2012		2011		2012	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	3.1 ± 2.2	—	0.0 ± 0.0	—	38.1 ± 26.5	—	0.0 ± 0.0	—
Chromis punctipinnis	8.8 ± 3.3	—	31.2 ± 9.0	—	435.3 ± 156.5	—	1079.4 ± 317.8	—
Embiotoca jacksoni	3.5 ± 1.1	—	1.7 ± 0.5	—	858.8 ± 347.4	—	93.7 ± 37.7	—
Girella nigricans	3.6 ± 1.8	—	4.4 ± 1.6	—	1374.7 ± 593.7	—	2178.4 ± 794.3	—
Hypsypops rubicundus	2.2 ± 0.6	—	3.0 ± 0.9	—	1126.8 ± 349.4	—	1215.1 ± 386.3	—
Oxyjulis californica	3.6 ± 1.0	—	2.6 ± 1.1	—	155.6 ± 46.1	—	114.8 ± 47.7	—
Paralabrax clathratus	3.8 ± 0.7	—	4.8 ± 0.7	—	2232.3 ± 442.4	—	2800.8 ± 428.5	—
Paralabrax nebulifer	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Scorpaenichthys marmoratus	0.0 ± 0.0	—	0.1 ± 0.1	—	0.0 ± 0.0	—	12.7 ± 12.7	—
Sebastes atrovirens	0.3 ± 0.1	—	0.8 ± 0.4	—	98.4 ± 49.0	—	269.1 ± 162.5	—
Sebastes auriculatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes carnatus	0.1 ± 0.1	—	0.1 ± 0.1	—	21.7 ± 21.7	—	36.1 ± 34.8	—
Sebastes caurinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes chrysomelas	0.2 ± 0.2	—	0.0 ± 0.0	—	52.1 ± 51.8	—	0.0 ± 0.0	—
Sebastes miniatus	0.0 ± 0.0	—	0.1 ± 0.1	—	0.0 ± 0.0	—	20.5 ± 20.5	—
Sebastes mystinus	0.7 ± 0.4	—	0.4 ± 0.4	—	39.3 ± 24.9	—	42.5 ± 18.4	—
Sebastes paucispinis	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes rastrelliger	0.1 ± 0.1	—	0.0 ± 0.0	—	45.7 ± 45.7	—	0.0 ± 0.0	—
Sebastes serranoides	0.1 ± 0.1	—	0.1 ± 0.1	—	2.4 ± 2.4	—	1.9 ± 1.3	—
Sebastes serriceps	0.1 ± 0.1	—	0.1 ± 0.1	—	51.2 ± 50.8	—	28.9 ± 20.4	—
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Semicossyphus pulcher	3.3 ± 0.5	—	2.6 ± 0.4	—	1718.9 ± 422.8	—	1650.6 ± 353.9	—
Stereolepis gigas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—

Table G.3. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Anacapa Island SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	9.9 ± 2.2	4.1 ± 1.9	4.2 ± 1.1	0.0 ± 0.0	132.0 ± 31.1	144.4 ± 74.5	58.5 ± 16.3	0.0 ± 0.0
Chromis punctipinnis	31.8 ± 6.6	25.2 ± 8.5	22.7 ± 4.4	29.7 ± 10.0	1563.5 ± 346.8	1141.9 ± 476.2	910.0 ± 180.4	2603.1 ± 1091.1
Embiotoca jacksoni	2.8 ± 0.5	3.5 ± 1.3	2.4 ± 0.6	4.4 ± 1.4	455.5 ± 84.3	1180.8 ± 540.4	172.3 ± 42.2	542.1 ± 165.2
Girella nigricans	2.9 ± 0.9	5.0 ± 2.7	3.5 ± 1.2	6.2 ± 3.0	1136.3 ± 342.4	1775.0 ± 785.4	1312.2 ± 401.6	2689.4 ± 1281.4
Hypsypops rubicundus	1.8 ± 0.4	2.2 ± 0.7	1.5 ± 0.3	0.8 ± 0.3	841.9 ± 193.5	976.6 ± 340.0	670.8 ± 144.2	441.1 ± 182.5
Oxyjulis californica	6.8 ± 2.2	7.2 ± 2.8	3.8 ± 0.7	5.3 ± 1.5	262.4 ± 81.1	271.3 ± 106.4	140.7 ± 25.7	257.2 ± 79.4
Paralabrax clathratus	7.0 ± 1.8	1.7 ± 0.4	5.0 ± 0.8	2.3 ± 0.5	3046.0 ± 718.8	719.6 ± 179.9	2347.9 ± 462.4	1451.8 ± 360.6
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	21.2 ± 21.2	21.2 ± 21.2
Sebastes atrovirens	1.0 ± 0.3	0.8 ± 0.3	0.6 ± 0.2	0.1 ± 0.1	145.3 ± 52.8	157.7 ± 57.5	72.4 ± 26.5	41.6 ± 29.0
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.2 ± 0.2	1.9 ± 1.3	0.9 ± 0.5	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.3 ± 0.2	0.1 ± 0.0	0.1 ± 0.1	0.5 ± 0.5	94.9 ± 58.3	3.7 ± 3.3	40.4 ± 40.4
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.2 ± 0.2	0.0 ± 0.0
Sebastes mystinus	0.4 ± 0.1	0.8 ± 0.5	0.0 ± 0.0	0.0 ± 0.0	18.6 ± 6.1	42.8 ± 26.1	15.6 ± 5.8	20.1 ± 11.2
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.2 ± 0.1	0.8 ± 0.3	0.2 ± 0.1	0.1 ± 0.1	8.7 ± 4.0	45.6 ± 22.9	11.7 ± 6.4	3.3 ± 2.0
Sebastes serriceps	0.1 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	22.2 ± 14.9	22.0 ± 16.4	25.1 ± 13.2	60.5 ± 43.4
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	2.0 ± 0.3	0.7 ± 0.3	1.4 ± 0.2	0.6 ± 0.2	1172.3 ± 245.8	319.7 ± 155.3	1105.6 ± 195.7	327.8 ± 125.3
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.4. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Arrow Point to Lion Head Point SMCA in 2011 and 2012.

	Density				Biomass Density			
Fish Species	2011		2012		2011		2012	
	MPA	Reference	MPA	Reference	MPA	Reference	MPA	Reference
Brachyistius frenatus	7.2 ± 3.2	—	11.1 ± 3.0	—	112.0 ± 46.6	—	206.6 ± 59.1	—
Chromis punctipinnis	35.6 ± 15.8	—	20.1 ± 6.4	—	1253.4 ± 642.4	—	708.2 ± 158.6	—
Embiotoca jacksoni	0.1 ± 0.1	—	0.3 ± 0.2	—	12.5 ± 9.8	—	7.0 ± 4.8	—
Girella nigricans	19.2 ± 16.0	—	2.4 ± 0.8	—	4858.3 ± 4292.6	—	437.0 ± 168.2	—
Hypsypops rubicundus	9.4 ± 1.6	—	7.4 ± 1.5	—	1903.6 ± 339.3	—	1439.1 ± 293.7	—
Oxyjulis californica	2.1 ± 0.5	—	8.9 ± 7.4	—	56.1 ± 17.5	—	252.9 ± 176.3	—
Paralabrax clathratus	8.1 ± 1.0	—	8.6 ± 2.1	—	786.1 ± 312.4	—	1373.0 ± 456.8	—
Paralabrax nebulifer	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Scorpaenichthys marmoratus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes atrovirens	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes auriculatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes carnatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes caurinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes chrysomelas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes miniatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes mystinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes paucispinis	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes rastrelliger	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serranoides	0.0 ± 0.0	—	0.0 ± 0.0	—	1.2 ± 1.2	—	0.0 ± 0.0	—
Sebastes serriceps	0.1 ± 0.1	—	0.0 ± 0.0	—	5.9 ± 3.2	—	0.0 ± 0.0	—
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Semicossyphus pulcher	2.9 ± 1.3	—	1.5 ± 0.8	—	605.1 ± 269.2	—	244.8 ± 116.8	—
Stereolepis gigas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—

Table G.6. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Begg Rock SMR in 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Chromis punctipinnis	—	—	13.8 ± 9.7	—	—	—	1315.2 ± 942.8	—
Embiotoca jacksoni	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Girella nigricans	—	—	2.9 ± 2.9	—	—	—	897.8 ± 897.8	—
Hypsypops rubicundus	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Oxyjulis californica	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Paralabrax clathratus	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Paralabrax nebulifer	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Scorpaenichthys marmoratus	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes atrovirens	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes auriculatus	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes carnatus	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes caurinus	—	—	0.1 ± 0.1	—	—	—	115.9 ± 115.9	—
Sebastes chrysomelas	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes miniatus	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes mystinus	—	—	4.7 ± 4.1	—	—	—	457.1 ± 419.6	—
Sebastes paucispinis	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes rastrelliger	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes serranoides	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes serriceps	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Sebastes umbrosus	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—
Semicossyphus pulcher	—	—	4.9 ± 2.0	—	—	—	5134.6 ± 2112.3	—
Stereolepis gigas	—	—	0.0 ± 0.0	—	—	—	0.0 ± 0.0	—

Table G.7. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Blue Cavern SMCA and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	7.5 ± 2.1	2.3 ± 0.7	2.6 ± 0.6	1.2 ± 0.4	105.6 ± 30.7	37.4 ± 16.4	27.5 ± 7.2	18.7 ± 6.5
Chromis punctipinnis	125.2 ± 26.1	339.9 ± 60.1	18.5 ± 7.1	260.5 ± 67.1	3805.2 ± 803.3	9289.9 ± 1672.2	852.4 ± 183.1	7381.3 ± 2035.6
Embiotoca jacksoni	0.1 ± 0.1	0.2 ± 0.1	0.1 ± 0.1	0.3 ± 0.3	13.4 ± 8.2	7.8 ± 4.4	3.8 ± 2.4	10.6 ± 9.4
Girella nigricans	2.6 ± 0.7	4.4 ± 1.1	8.9 ± 4.3	7.4 ± 1.9	628.6 ± 201.7	1153.7 ± 309.4	1879.7 ± 922.9	1699.5 ± 408.9
Hypsypops rubicundus	6.3 ± 1.9	3.0 ± 0.6	5.4 ± 1.2	5.6 ± 1.3	1420.9 ± 462.5	562.8 ± 119.7	1266.4 ± 308.4	870.9 ± 180.5
Oxyjulis californica	2.8 ± 1.7	2.5 ± 1.5	3.9 ± 2.4	2.1 ± 0.6	47.6 ± 18.9	78.4 ± 52.9	86.6 ± 28.8	64.0 ± 15.6
Paralabrax clathratus	6.9 ± 1.2	4.2 ± 0.7	14.9 ± 2.1	4.7 ± 1.0	1398.1 ± 306.4	754.7 ± 187.6	2766.3 ± 538.1	726.3 ± 166.4
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	25.4 ± 25.4	0.0 ± 0.0
Sebastes atrovirens	0.2 ± 0.1	0.8 ± 0.4	0.3 ± 0.2	0.0 ± 0.0	21.6 ± 9.3	140.8 ± 73.3	9.0 ± 7.6	0.0 ± 0.0
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serriceps	0.2 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.2 ± 0.2	24.3 ± 13.0	0.0 ± 0.0	0.0 ± 0.0	49.3 ± 34.9
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	5.0 ± 0.7	2.3 ± 0.3	3.7 ± 0.7	3.9 ± 1.0	1120.9 ± 205.1	510.7 ± 171.0	870.7 ± 170.7	686.9 ± 206.4
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.8. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Cabrillo SMR and reference sites in 2011 and 2012.

	Density				**Biomass Density**			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	2.5 ± 1.4	—	0.6 ± 0.4	15.7 ± 8.6	16.7 ± 7.9	—	5.7 ± 3.9	249.1 ± 143.0
Chromis punctipinnis	4.0 ± 4.0	—	8.2 ± 4.9	3.5 ± 2.6	62.7 ± 62.7	—	367.0 ± 217.1	143.0 ± 59.6
Embiotoca jacksoni	0.6 ± 0.6	—	0.1 ± 0.1	0.5 ± 0.2	39.6 ± 37.4	—	8.1 ± 8.1	92.9 ± 47.7
Girella nigricans	0.0 ± 0.0	—	1.4 ± 1.4	0.8 ± 0.6	0.0 ± 0.0	—	412.9 ± 412.9	408.9 ± 323.9
Hypsypops rubicundus	0.2 ± 0.2	—	0.6 ± 0.4	2.5 ± 1.0	50.1 ± 50.1	—	113.8 ± 78.1	541.8 ± 212.7
Oxyjulis californica	0.6 ± 0.4	—	1.4 ± 0.8	5.9 ± 2.2	101.8 ± 68.8	—	31.5 ± 14.8	165.9 ± 54.8
Paralabrax clathratus	2.5 ± 1.4	—	2.8 ± 1.0	4.4 ± 0.9	663.9 ± 369.9	—	970.4 ± 386.1	1188.5 ± 313.4
Paralabrax nebulifer	0.2 ± 0.2	—	0.1 ± 0.1	0.2 ± 0.1	122.8 ± 122.8	—	81.9 ± 81.9	153.0 ± 106.8
Scorpaenichthys marmoratus	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	0.8 ± 0.6	—	0.1 ± 0.1	0.2 ± 0.1	163.1 ± 135.5	—	7.7 ± 7.7	38.1 ± 27.4
Sebastes auriculatus	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	—	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	—	0.0 ± 0.0	27.4 ± 27.4
Sebastes mystinus	0.0 ± 0.0	—	0.0 ± 0.0	0.2 ± 0.2	0.0 ± 0.0	—	0.0 ± 0.0	8.9 ± 8.9
Sebastes paucispinis	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.4 ± 0.4	—	0.0 ± 0.0	1.0 ± 0.7	4.9 ± 4.9	—	0.0 ± 0.0	80.2 ± 54.5
Sebastes serriceps	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	—	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	1.9 ± 0.9	—	2.4 ± 1.3	2.3 ± 0.6	1502.1 ± 662.5	—	3741.1 ± 1900.9	1202.0 ± 402.7
Stereolepis gigas	0.0 ± 0.0	—	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	—	15956.2 ± 15956.2	0.0 ± 0.0

Table G.9. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Campus Point SMCA in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	5.9 ± 2.9	—	16.2 ± 6.5	—	79.5 ± 35.3	—	170.8 ± 78.4	—
Chromis punctipinnis	0.2 ± 0.2	—	0.0 ± 0.0	—	4.3 ± 4.3	—	0.0 ± 0.0	—
Embiotoca jacksoni	2.6 ± 0.9	—	0.3 ± 0.3	—	346.1 ± 136.7	—	174.0 ± 139.0	—
Girella nigricans	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Hypsypops rubicundus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Oxyjulis californica	7.3 ± 3.1	—	7.1 ± 2.4	—	229.7 ± 83.7	—	285.1 ± 82.0	—
Paralabrax clathratus	1.2 ± 0.4	—	1.9 ± 0.8	—	507.9 ± 149.0	—	1345.1 ± 568.3	—
Paralabrax nebulifer	0.1 ± 0.1	—	0.1 ± 0.1	—	43.0 ± 43.0	—	185.6 ± 128.6	—
Scorpaenichthys marmoratus	0.1 ± 0.1	—	0.0 ± 0.0	—	32.3 ± 32.3	—	0.4 ± 0.4	—
Sebastes atrovirens	0.3 ± 0.2	—	0.8 ± 0.3	—	143.9 ± 108.0	—	395.1 ± 138.5	—
Sebastes auriculatus	0.1 ± 0.1	—	0.4 ± 0.2	—	8.5 ± 4.8	—	141.7 ± 92.8	—
Sebastes carnatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes caurinus	0.0 ± 0.0	—	0.1 ± 0.1	—	2.4 ± 1.8	—	43.7 ± 39.6	—
Sebastes chrysomelas	0.0 ± 0.0	—	0.1 ± 0.1	—	0.0 ± 0.0	—	40.2 ± 40.2	—
Sebastes miniatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes mystinus	0.1 ± 0.1	—	0.1 ± 0.1	—	2.7 ± 2.1	—	16.3 ± 8.3	—
Sebastes paucispinis	0.0 ± 0.0	—	0.1 ± 0.1	—	0.7 ± 0.7	—	1.5 ± 1.0	—
Sebastes rastrelliger	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serranoides	0.3 ± 0.2	—	0.3 ± 0.1	—	6.4 ± 4.0	—	18.1 ± 11.5	—
Sebastes serriceps	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Semicossyphus pulcher	0.2 ± 0.1	—	0.5 ± 0.4	—	213.1 ± 174.2	—	433.0 ± 403.9	—
Stereolepis gigas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—

Table G.10. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Cat Harbor SMCA and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	7.2 ± 3.0	8.1 ± 1.4	2.9 ± 1.0	2.1 ± 0.8	106.1 ± 42.7	123.3 ± 24.2	47.8 ± 19.9	26.5 ± 12.5
Chromis punctipinnis	6.9 ± 5.0	65.8 ± 22.1	2.6 ± 2.1	12.5 ± 5.2	173.3 ± 83.8	1424.3 ± 470.2	68.8 ± 52.1	220.0 ± 93.0
Embiotoca jacksoni	1.0 ± 0.6	3.2 ± 1.0	1.0 ± 0.4	1.2 ± 0.4	66.5 ± 37.4	283.9 ± 76.0	51.4 ± 16.8	84.6 ± 28.3
Girella nigricans	9.0 ± 5.1	1.4 ± 0.6	2.6 ± 1.5	0.1 ± 0.1	2241.5 ± 1126.4	392.8 ± 188.5	1063.2 ± 675.7	41.3 ± 41.3
Hypsypops rubicundus	2.5 ± 0.9	4.2 ± 0.9	1.7 ± 0.8	2.2 ± 0.7	601.1 ± 223.3	696.0 ± 176.6	400.7 ± 191.0	234.4 ± 68.4
Oxyjulis californica	5.4 ± 2.7	3.6 ± 2.4	2.6 ± 1.1	1.0 ± 0.5	251.6 ± 137.6	149.6 ± 94.5	153.6 ± 70.9	101.7 ± 67.2
Paralabrax clathratus	13.9 ± 3.3	6.2 ± 1.3	14.0 ± 3.4	3.3 ± 1.1	2488.0 ± 788.3	492.5 ± 85.9	1243.6 ± 388.6	412.9 ± 166.1
Paralabrax nebulifer	0.4 ± 0.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	111.3 ± 61.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	0.3 ± 0.3	0.4 ± 0.2	0.0 ± 0.0	0.7 ± 0.5	1.1 ± 1.1	58.5 ± 36.0	1.2 ± 1.2	36.0 ± 24.5
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	71.1 ± 71.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.2 ± 2.2	0.0 ± 0.0	0.0 ± 0.0
Sebastes serriceps	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	4.1 ± 4.1	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	4.3 ± 1.8	4.3 ± 1.2	1.8 ± 0.6	1.4 ± 0.5	1300.9 ± 747.3	862.9 ± 271.1	640.3 ± 291.4	252.8 ± 87.1
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.11. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Crystal Cove SMCA in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	13.2 ± 3.8	—	3.6 ± 2.0	—	276.7 ± 79.9	—	29.2 ± 16.3	—
Chromis punctipinnis	5.6 ± 2.7	—	5.7 ± 2.6	—	131.9 ± 65.0	—	213.6 ± 88.8	—
Embiotoca jacksoni	2.2 ± 0.5	—	0.8 ± 0.4	—	127.6 ± 34.6	—	43.0 ± 21.8	—
Girella nigricans	1.2 ± 0.8	—	0.6 ± 0.4	—	474.3 ± 315.3	—	229.4 ± 215.1	—
Hypsypops rubicundus	16.1 ± 3.5	—	5.1 ± 1.3	—	3282.2 ± 789.7	—	1625.0 ± 673.2	—
Oxyjulis californica	36.5 ± 6.8	—	6.8 ± 2.9	—	1517.0 ± 360.5	—	177.6 ± 71.5	—
Paralabrax clathratus	4.0 ± 1.2	—	0.8 ± 0.4	—	361.6 ± 141.2	—	63.3 ± 47.0	—
Paralabrax nebulifer	0.0 ± 0.0	—	0.1 ± 0.1	—	0.0 ± 0.0	—	51.6 ± 51.6	—
Scorpaenichthys marmoratus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes atrovirens	0.7 ± 0.4	—	0.1 ± 0.1	—	28.0 ± 16.7	—	7.7 ± 7.7	—
Sebastes auriculatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes carnatus	0.3 ± 0.3	—	0.0 ± 0.0	—	15.4 ± 15.4	—	0.0 ± 0.0	—
Sebastes caurinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes chrysomelas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes miniatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes mystinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes paucispinis	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes rastrelliger	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serranoides	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	1.3 ± 1.3	—
Sebastes serriceps	0.3 ± 0.2	—	0.0 ± 0.0	—	18.0 ± 12.2	—	0.0 ± 0.0	—
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Semicossyphus pulcher	9.6 ± 2.5	—	2.5 ± 0.5	—	1868.0 ± 567.8	—	179.1 ± 50.8	—
Stereolepis gigas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—

Table G.12. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Dana Point SMCA in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	30.6 ± 17.5	—	9.4 ± 6.2	—	342.4 ± 185.8	—	77.4 ± 52.0	—
Chromis punctipinnis	0.6 ± 0.4	—	1.2 ± 0.7	—	16.2 ± 10.6	—	258.9 ± 108.3	—
Embiotoca jacksoni	1.9 ± 1.2	—	0.7 ± 0.2	—	84.0 ± 55.1	—	28.2 ± 10.8	—
Girella nigricans	0.0 ± 0.0	—	0.6 ± 0.4	—	0.0 ± 0.0	—	288.0 ± 221.4	—
Hypsypops rubicundus	0.0 ± 0.0	—	0.3 ± 0.2	—	0.0 ± 0.0	—	66.8 ± 45.0	—
Oxyjulis californica	10.2 ± 6.1	—	0.3 ± 0.2	—	366.5 ± 204.6	—	7.3 ± 4.7	—
Paralabrax clathratus	2.7 ± 1.0	—	3.3 ± 1.0	—	341.6 ± 154.7	—	534.6 ± 158.5	—
Paralabrax nebulifer	0.6 ± 0.3	—	3.9 ± 1.1	—	290.4 ± 157.3	—	1696.8 ± 674.6	—
Scorpaenichthys marmoratus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes atrovirens	0.2 ± 0.2	—	0.3 ± 0.2	—	49.9 ± 49.9	—	89.3 ± 62.5	—
Sebastes auriculatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes carnatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes caurinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes chrysomelas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes miniatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes mystinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes paucispinis	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes rastrelliger	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serranoides	0.2 ± 0.2	—	0.0 ± 0.0	—	8.8 ± 8.8	—	0.0 ± 0.0	—
Sebastes serriceps	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Semicossyphus pulcher	0.8 ± 0.6	—	2.2 ± 0.9	—	161.3 ± 113.9	—	1272.3 ± 727.8	—
Stereolepis gigas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—

Table G.13. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Farnsworth Onshore SMCA and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	2.6 ± 1.3	4.2 ± 1.7	0.3 ± 0.2	2.1 ± 0.6	21.0 ± 9.8	211.6 ± 183.5	4.1 ± 2.8	24.7 ± 7.6
Chromis punctipinnis	11.1 ± 4.8	9.7 ± 2.8	5.8 ± 3.2	1.4 ± 1.4	453.5 ± 192.9	323.8 ± 86.8	160.8 ± 68.5	123.4 ± 31.2
Embiotoca jacksoni	1.7 ± 0.4	2.5 ± 1.0	0.0 ± 0.0	1.5 ± 0.8	196.3 ± 61.3	156.7 ± 77.5	1.1 ± 1.1	42.0 ± 21.8
Girella nigricans	1.2 ± 0.5	1.2 ± 0.6	5.8 ± 2.9	4.3 ± 1.4	371.6 ± 138.1	249.3 ± 102.0	935.9 ± 509.2	1154.4 ± 389.0
Hypsypops rubicundus	2.2 ± 1.2	2.8 ± 0.4	1.9 ± 0.6	2.8 ± 0.8	450.4 ± 292.3	465.5 ± 98.7	528.5 ± 204.9	975.6 ± 444.9
Oxyjulis californica	15.4 ± 8.5	9.3 ± 1.8	1.1 ± 0.6	3.1 ± 2.3	259.8 ± 113.5	281.7 ± 61.2	52.7 ± 15.6	89.2 ± 64.2
Paralabrax clathratus	9.0 ± 2.4	5.8 ± 1.1	6.0 ± 1.6	4.9 ± 1.3	1295.6 ± 383.3	776.1 ± 155.8	1078.6 ± 272.5	500.6 ± 151.5
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	0.1 ± 0.1	0.6 ± 0.3	0.0 ± 0.0	0.3 ± 0.2	0.9 ± 0.9	101.7 ± 58.5	0.0 ± 0.0	89.3 ± 62.5
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.0 ± 0.0	0.6 ± 0.3	0.0 ± 0.0	0.3 ± 0.2	0.0 ± 0.0	38.4 ± 23.6	3.5 ± 2.5	9.3 ± 7.2
Sebastes serriceps	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	4.6 ± 1.5	4.2 ± 1.2	5.6 ± 1.1	1.9 ± 0.6	1017.8 ± 272.6	737.5 ± 213.8	915.8 ± 233.5	136.4 ± 40.2
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.14. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Gull Island SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	6.2 ± 2.5	3.5 ± 0.9	1.2 ± 0.6	5.4 ± 3.3	79.9 ± 39.2	40.1 ± 13.0	24.7 ± 14.5	68.0 ± 41.3
Chromis punctipinnis	34.8 ± 12.8	6.6 ± 2.7	3.4 ± 1.4	7.8 ± 2.4	2268.0 ± 929.2	311.5 ± 125.1	200.0 ± 96.4	425.9 ± 132.3
Embiotoca jacksoni	2.6 ± 0.6	1.3 ± 0.3	1.9 ± 0.6	1.5 ± 0.4	867.9 ± 257.4	238.8 ± 60.3	507.3 ± 171.9	202.7 ± 50.9
Girella nigricans	2.1 ± 0.6	1.6 ± 0.6	2.0 ± 1.0	1.3 ± 0.8	1177.8 ± 350.5	955.4 ± 406.1	1586.0 ± 788.7	641.7 ± 359.0
Hypsypops rubicundus	0.8 ± 0.3	0.5 ± 0.2	0.5 ± 0.2	1.0 ± 0.3	409.1 ± 151.4	233.3 ± 86.8	238.8 ± 97.4	430.5 ± 116.7
Oxyjulis californica	20.1 ± 6.4	11.8 ± 2.6	49.0 ± 23.6	6.2 ± 1.2	1081.2 ± 380.3	591.0 ± 139.0	1959.0 ± 968.4	355.8 ± 67.4
Paralabrax clathratus	2.8 ± 0.8	2.0 ± 0.4	1.5 ± 0.6	1.9 ± 0.4	1436.3 ± 333.9	1054.2 ± 198.8	1331.7 ± 520.2	1002.9 ± 185.5
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.4 ± 0.2	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	431.0 ± 246.6	0.0 ± 0.0	36.4 ± 36.4	0.0 ± 0.0
Sebastes atrovirens	5.6 ± 1.1	0.9 ± 0.2	1.2 ± 0.4	0.9 ± 0.4	1422.6 ± 275.7	189.8 ± 61.2	282.6 ± 86.9	193.4 ± 104.5
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.6 ± 5.6
Sebastes carnatus	0.7 ± 0.2	0.1 ± 0.0	0.3 ± 0.2	0.1 ± 0.0	164.0 ± 64.7	10.9 ± 9.8	64.7 ± 36.7	19.4 ± 14.5
Sebastes caurinus	0.2 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	0.1 ± 0.0	150.8 ± 112.2	11.3 ± 8.7	0.0 ± 0.0	12.1 ± 9.4
Sebastes chrysomelas	0.5 ± 0.2	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	90.0 ± 48.0	0.0 ± 0.0	31.3 ± 29.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	1.3 ± 1.3	1.3 ± 1.3	6.5 ± 5.9
Sebastes mystinus	4.6 ± 1.8	0.2 ± 0.1	0.5 ± 0.2	0.2 ± 0.2	515.9 ± 360.9	13.2 ± 6.9	153.1 ± 57.3	61.1 ± 51.2
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	49.5 ± 49.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	2.6 ± 0.9	0.5 ± 0.2	0.8 ± 0.4	0.6 ± 0.2	296.8 ± 189.9	30.6 ± 15.7	488.2 ± 303.6	38.7 ± 19.3
Sebastes serriceps	0.5 ± 0.3	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	110.6 ± 55.1	0.2 ± 0.2	44.7 ± 31.2	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	6.9 ± 0.7	1.6 ± 0.3	3.4 ± 0.6	1.4 ± 0.4	6323.8 ± 1203.7	582.5 ± 132.8	2517.4 ± 649.3	668.8 ± 219.5
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.15. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Harris Point SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	0.0 ± 0.0	0.9 ± 0.4	1.9 ± 1.1	2.5 ± 0.5	0.0 ± 0.0	14.1 ± 7.6	14.6 ± 7.6	27.3 ± 6.1
Chromis punctipinnis	36.4 ± 15.7	0.7 ± 0.6	3.6 ± 1.3	3.1 ± 2.1	4055.9 ± 1897.8	142.8 ± 108.6	400.0 ± 126.5	396.8 ± 287.7
Embiotoca jacksoni	2.8 ± 1.1	0.5 ± 0.1	0.5 ± 0.3	0.5 ± 0.1	338.5 ± 185.7	226.8 ± 72.2	102.8 ± 69.4	268.1 ± 81.5
Girella nigricans	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Hypsypops rubicundus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Oxyjulis californica	39.2 ± 24.9	4.1 ± 1.6	4.6 ± 1.6	4.3 ± 1.5	2171.9 ± 1299.4	216.3 ± 84.4	177.0 ± 62.5	198.8 ± 72.1
Paralabrax clathratus	0.2 ± 0.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	208.4 ± 161.9	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.2 ± 0.1	0.1 ± 0.1	0.3 ± 0.2	0.2 ± 0.1	467.3 ± 271.1	99.3 ± 44.0	546.9 ± 268.1	264.8 ± 114.8
Sebastes atrovirens	3.8 ± 1.1	8.4 ± 1.4	2.4 ± 0.8	5.8 ± 1.2	1624.2 ± 520.1	2679.8 ± 462.6	476.6 ± 210.8	1603.1 ± 331.0
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.2 ± 0.2	0.6 ± 0.2	0.1 ± 0.1	0.4 ± 0.2	1.3 ± 1.0	164.7 ± 66.4	19.6 ± 19.6	106.7 ± 42.7
Sebastes caurinus	0.4 ± 0.3	0.4 ± 0.2	1.1 ± 0.3	0.6 ± 0.2	562.6 ± 340.5	339.8 ± 110.4	795.7 ± 246.0	400.9 ± 135.0
Sebastes chrysomelas	0.3 ± 0.2	0.5 ± 0.1	1.0 ± 0.3	0.1 ± 0.1	16.5 ± 15.7	157.7 ± 53.1	250.3 ± 80.8	38.6 ± 17.8
Sebastes miniatus	1.2 ± 0.7	0.3 ± 0.1	0.3 ± 0.2	0.1 ± 0.0	304.7 ± 207.1	207.8 ± 106.8	93.1 ± 58.1	46.3 ± 27.0
Sebastes mystinus	22.4 ± 5.9	15.5 ± 4.9	5.1 ± 1.5	11.7 ± 3.2	2951.4 ± 796.3	3330.8 ± 984.3	977.7 ± 317.0	2747.2 ± 964.5
Sebastes paucispinis	0.0 ± 0.0	0.5 ± 0.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.5 ± 2.5	0.0 ± 0.0	0.3 ± 0.3
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	7.5 ± 5.6
Sebastes serranoides	8.2 ± 2.4	1.5 ± 0.4	1.8 ± 0.9	2.0 ± 0.5	1660.9 ± 485.0	459.7 ± 158.0	481.7 ± 270.9	600.3 ± 179.5
Sebastes serriceps	0.0 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.2 ± 0.1	0.0 ± 0.0	36.1 ± 25.2	55.9 ± 38.7	83.8 ± 29.2
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	0.8 ± 0.3	0.4 ± 0.1	0.8 ± 0.3	0.1 ± 0.1	898.7 ± 341.8	810.1 ± 243.6	1210.1 ± 578.2	253.4 ± 138.1
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.16. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Laguna Beach SMR in 2011 and 2012.

	Density				**Biomass Density**			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	2.1 ± 0.5	—	8.5 ± 4.5	—	27.8 ± 7.1	—	72.1 ± 43.0	—
Chromis punctipinnis	11.0 ± 6.2	—	1.0 ± 0.4	—	214.4 ± 117.6	—	541.8 ± 175.1	—
Embiotoca jacksoni	1.1 ± 0.8	—	1.5 ± 0.6	—	69.3 ± 53.6	—	56.0 ± 23.9	—
Girella nigricans	0.3 ± 0.2	—	1.9 ± 0.7	—	62.2 ± 44.6	—	429.5 ± 172.5	—
Hypsypops rubicundus	5.4 ± 1.5	—	13.9 ± 4.9	—	1018.1 ± 277.3	—	1896.4 ± 703.8	—
Oxyjulis californica	9.0 ± 3.8	—	0.7 ± 0.3	—	602.1 ± 306.0	—	20.1 ± 10.4	—
Paralabrax clathratus	0.1 ± 0.1	—	1.5 ± 0.4	—	27.7 ± 27.7	—	176.4 ± 63.7	—
Paralabrax nebulifer	0.6 ± 0.3	—	0.8 ± 0.4	—	193.2 ± 110.1	—	471.0 ± 239.1	—
Scorpaenichthys marmoratus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes atrovirens	0.0 ± 0.0	—	0.3 ± 0.2	—	0.0 ± 0.0	—	25.3 ± 18.5	—
Sebastes auriculatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes carnatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes caurinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes chrysomelas	0.0 ± 0.0	—	0.1 ± 0.1	—	0.0 ± 0.0	—	9.3 ± 9.3	—
Sebastes miniatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes mystinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes paucispinis	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes rastrelliger	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serranoides	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serriceps	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Semicossyphus pulcher	3.8 ± 1.0	—	3.9 ± 1.2	—	1102.5 ± 389.2	—	1167.2 ± 374.9	—
Stereolepis gigas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—

Table G.17. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Long Point SMR and reference sites in 2011 and 2012.

	Density				**Biomass Density**			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	5.6 ± 1.2	4.3 ± 1.6	3.2 ± 1.6	2.4 ± 0.8	78.7 ± 16.5	66.2 ± 27.6	25.9 ± 12.2	28.2 ± 11.5
Chromis punctipinnis	20.1 ± 8.0	57.5 ± 23.5	7.1 ± 6.9	27.6 ± 14.5	1049.8 ± 489.0	1667.4 ± 549.0	898.8 ± 286.4	743.1 ± 340.8
Embiotoca jacksoni	0.4 ± 0.3	0.4 ± 0.3	0.1 ± 0.1	0.6 ± 0.3	18.1 ± 16.1	19.0 ± 16.0	2.0 ± 2.0	17.0 ± 10.1
Girella nigricans	3.2 ± 2.1	3.6 ± 2.7	1.0 ± 0.4	3.3 ± 1.2	929.3 ± 639.7	788.2 ± 614.6	158.4 ± 61.4	616.0 ± 244.8
Hypsypops rubicundus	8.1 ± 2.2	7.8 ± 1.7	5.4 ± 0.9	6.8 ± 1.4	1493.9 ± 419.0	1116.1 ± 271.5	771.1 ± 156.4	1203.7 ± 244.0
Oxyjulis californica	18.1 ± 8.7	21.1 ± 9.7	0.3 ± 0.2	0.6 ± 0.3	391.1 ± 140.3	438.1 ± 197.8	39.3 ± 31.7	56.3 ± 21.5
Paralabrax clathratus	12.9 ± 3.4	5.7 ± 1.5	5.8 ± 0.8	6.8 ± 1.2	545.0 ± 153.2	541.0 ± 206.7	443.8 ± 113.2	563.0 ± 166.6
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	1.4 ± 0.8	0.0 ± 0.0	0.0 ± 0.0	0.3 ± 0.3	15.1 ± 8.8	0.0 ± 0.0	0.0 ± 0.0	11.8 ± 11.8
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.2 ± 2.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serriceps	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	1.4 ± 0.5	1.8 ± 0.6	1.0 ± 0.4	0.6 ± 0.3	236.3 ± 117.1	175.4 ± 73.3	137.7 ± 67.2	90.2 ± 58.6
Stereolepis gigas	0.3 ± 0.3	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	20453.9 ± 20453.9	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.18. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Lover's Cove SMCA in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	1.4 ± 0.6	—	6.5 ± 3.3	—	11.1 ± 4.9	—	61.4 ± 36.0	—
Chromis punctipinnis	37.1 ± 11.7	—	2.4 ± 1.5	—	918.2 ± 321.9	—	379.2 ± 161.6	—
Embiotoca jacksoni	0.0 ± 0.0	—	1.0 ± 0.6	—	0.0 ± 0.0	—	39.4 ± 21.9	—
Girella nigricans	4.7 ± 2.6	—	17.9 ± 10.3	—	1077.7 ± 556.9	—	4707.2 ± 2686.4	—
Hypsypops rubicundus	5.0 ± 0.8	—	6.0 ± 1.3	—	709.8 ± 112.2	—	715.2 ± 197.3	—
Oxyjulis californica	0.4 ± 0.4	—	0.4 ± 0.3	—	7.5 ± 7.5	—	11.6 ± 8.6	—
Paralabrax clathratus	18.5 ± 5.3	—	36.9 ± 9.7	—	10832.6 ± 3866.8	—	17921.4 ± 5961.2	—
Paralabrax nebulifer	0.1 ± 0.1	—	0.0 ± 0.0	—	122.1 ± 122.1	—	0.0 ± 0.0	—
Scorpaenichthys marmoratus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes atrovirens	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.3 ± 0.3	—
Sebastes auriculatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes carnatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes caurinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes chrysomelas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes miniatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes mystinus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes paucispinis	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes rastrelliger	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serranoides	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serriceps	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Semicossyphus pulcher	7.8 ± 2.4	—	2.8 ± 1.1	—	2710.9 ± 906.3	—	750.2 ± 294.1	—
Stereolepis gigas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—

Table G.19. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Matlahuayl SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	2011		2012		2011		2012	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	10.6 ± 4.0	4.6 ± 2.6	9.2 ± 5.9	6.8 ± 3.8	107.7 ± 46.0	48.2 ± 25.2	144.2 ± 86.9	142.5 ± 84.5
Chromis punctipinnis	0.2 ± 0.2	10.8 ± 5.8	11.5 ± 7.6	0.8 ± 0.8	15.6 ± 10.9	329.5 ± 179.9	416.3 ± 260.2	102.3 ± 78.4
Embiotoca jacksoni	0.4 ± 0.4	0.1 ± 0.1	0.6 ± 0.4	0.1 ± 0.1	25.5 ± 25.5	8.1 ± 8.1	36.3 ± 25.4	3.7 ± 3.7
Girella nigricans	11.7 ± 11.4	1.4 ± 0.8	0.6 ± 0.4	0.0 ± 0.0	3070.9 ± 3000.7	196.9 ± 126.9	324.0 ± 227.2	0.0 ± 0.0
Hypsypops rubicundus	1.5 ± 0.7	2.9 ± 1.2	2.3 ± 1.1	3.1 ± 1.5	261.8 ± 120.4	484.1 ± 200.6	491.8 ± 235.7	635.9 ± 318.5
Oxyjulis californica	10.2 ± 4.8	16.9 ± 3.2	2.1 ± 1.0	14.6 ± 7.7	412.8 ± 188.2	642.5 ± 127.1	125.4 ± 42.5	477.0 ± 173.3
Paralabrax clathratus	9.4 ± 1.1	1.4 ± 0.5	9.2 ± 2.4	2.5 ± 1.2	2835.8 ± 870.8	139.4 ± 50.8	2926.6 ± 710.7	441.1 ± 184.2
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	0.0 ± 0.0	0.3 ± 0.3	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	35.1 ± 35.1	0.0 ± 0.0	0.0 ± 0.0
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.2 ± 0.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.5 ± 2.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serriceps	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	1.2 ± 1.0	1.1 ± 0.7	2.5 ± 0.8	0.7 ± 0.2	713.0 ± 528.7	334.2 ± 181.5	1063.0 ± 396.8	153.5 ± 67.8
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.20. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Naples SMCA and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	3.2 ± 1.0	5.6 ± 2.2	30.8 ± 10.4	18.5 ± 6.9	34.0 ± 10.6	73.3 ± 31.4	224.7 ± 75.7	200.7 ± 66.7
Chromis punctipinnis	0.6 ± 0.4	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	38.3 ± 31.0	0.0 ± 0.0	9.8 ± 8.3	0.0 ± 0.0
Embiotoca jacksoni	2.4 ± 0.6	3.2 ± 1.2	3.5 ± 0.7	4.2 ± 1.1	541.6 ± 174.2	426.5 ± 100.2	1058.0 ± 234.4	601.5 ± 241.4
Girella nigricans	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	132.8 ± 94.0	0.0 ± 0.0	0.0 ± 0.0
Hypsypops rubicundus	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	22.5 ± 22.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Oxyjulis californica	14.3 ± 4.6	36.0 ± 11.7	18.0 ± 4.6	14.8 ± 4.4	594.2 ± 251.9	2356.2 ± 810.0	817.4 ± 262.7	928.6 ± 302.6
Paralabrax clathratus	1.0 ± 0.2	1.1 ± 0.3	1.2 ± 0.5	0.6 ± 0.3	618.4 ± 166.1	636.5 ± 223.1	648.2 ± 243.0	543.2 ± 345.2
Paralabrax nebulifer	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	31.3 ± 31.3	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.5 ± 0.2	0.0 ± 0.0	0.6 ± 0.2	0.0 ± 0.0	285.3 ± 124.1	0.0 ± 0.0	369.1 ± 114.7	0.0 ± 0.0
Sebastes atrovirens	0.2 ± 0.1	2.1 ± 0.9	1.7 ± 0.6	0.7 ± 0.3	48.6 ± 27.4	406.5 ± 192.4	472.0 ± 199.1	151.2 ± 92.1
Sebastes auriculatus	0.1 ± 0.1	1.0 ± 0.4	0.2 ± 0.1	0.1 ± 0.1	32.4 ± 28.3	213.2 ± 96.8	45.8 ± 40.6	51.9 ± 41.7
Sebastes carnatus	0.9 ± 0.4	0.1 ± 0.1	0.3 ± 0.1	0.1 ± 0.1	129.8 ± 62.0	0.9 ± 0.7	67.5 ± 37.9	0.9 ± 0.9
Sebastes caurinus	0.1 ± 0.1	0.2 ± 0.2	0.3 ± 0.2	0.2 ± 0.1	4.5 ± 2.7	68.3 ± 46.3	54.7 ± 39.7	130.4 ± 75.3
Sebastes chrysomelas	0.2 ± 0.1	0.6 ± 0.3	0.6 ± 0.2	0.1 ± 0.1	17.5 ± 15.3	124.0 ± 72.1	170.8 ± 67.2	17.6 ± 17.6
Sebastes miniatus	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	6.7 ± 5.5	0.0 ± 0.0	0.0 ± 0.0	0.7 ± 0.7
Sebastes mystinus	1.8 ± 1.1	0.2 ± 0.2	2.4 ± 1.0	0.4 ± 0.4	100.2 ± 56.6	9.8 ± 8.7	149.1 ± 47.0	53.5 ± 52.4
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	1.9 ± 1.9	2.8 ± 2.3	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.3 ± 0.2	0.3 ± 0.2	2.2 ± 0.8	0.6 ± 0.5	9.3 ± 5.9	28.8 ± 20.0	98.6 ± 36.8	9.3 ± 7.3
Sebastes serriceps	0.1 ± 0.1	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	19.7 ± 19.7	0.0 ± 0.0	50.8 ± 50.8	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	1.9 ± 0.5	0.7 ± 0.3	1.5 ± 0.5	0.2 ± 0.2	1411.9 ± 382.2	577.8 ± 300.0	908.6 ± 302.2	172.5 ± 133.8
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.21. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Painted Cave SMCA and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	2011		2012		2011		2012	
	MPA	Reference	MPA	Reference	MPA	Reference	MPA	Reference
Brachyistius frenatus	0.5 ± 0.3	16.4 ± 3.3	0.0 ± 0.0	9.3 ± 1.8	10.2 ± 7.0	137.0 ± 27.9	0.0 ± 0.0	67.1 ± 14.0
Chromis punctipinnis	9.3 ± 5.0	8.1 ± 1.9	23.2 ± 8.1	7.6 ± 2.6	538.7 ± 284.3	394.3 ± 93.7	1439.6 ± 607.9	482.4 ± 140.0
Embiotoca jacksoni	1.1 ± 0.3	2.6 ± 0.6	1.7 ± 0.5	2.5 ± 0.5	518.8 ± 144.5	710.9 ± 121.9	414.9 ± 145.2	422.0 ± 88.9
Girella nigricans	1.5 ± 0.6	0.6 ± 0.2	2.8 ± 1.2	1.8 ± 0.9	834.7 ± 346.9	305.4 ± 112.7	1762.4 ± 661.4	1079.1 ± 578.6
Hypsypops rubicundus	0.3 ± 0.2	0.1 ± 0.1	0.1 ± 0.1	0.3 ± 0.1	126.0 ± 72.8	55.2 ± 33.2	55.2 ± 38.3	122.9 ± 61.4
Oxyjulis californica	6.1 ± 1.6	9.1 ± 1.7	16.2 ± 4.2	7.6 ± 1.7	241.3 ± 69.1	379.1 ± 76.1	553.5 ± 132.6	348.1 ± 72.4
Paralabrax clathratus	1.8 ± 0.5	2.5 ± 0.4	2.9 ± 1.0	2.4 ± 0.7	1191.1 ± 343.9	1015.8 ± 191.0	2425.6 ± 852.0	857.6 ± 228.3
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.1 ± 0.1	0.0 ± 0.0	0.2 ± 0.1	0.0 ± 0.0	155.7 ± 120.7	11.9 ± 11.9	118.3 ± 69.4	46.6 ± 46.6
Sebastes atrovirens	2.6 ± 1.2	11.4 ± 2.5	1.0 ± 0.4	3.4 ± 0.8	485.7 ± 201.0	1101.9 ± 292.3	389.1 ± 126.9	507.5 ± 144.3
Sebastes auriculatus	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.2 ± 0.1	0.0 ± 0.0	21.5 ± 11.9	0.0 ± 0.0	6.7 ± 3.8
Sebastes carnatus	0.6 ± 0.4	0.0 ± 0.0	0.4 ± 0.2	0.1 ± 0.1	140.1 ± 91.3	0.0 ± 0.0	65.6 ± 35.9	1.5 ± 1.5
Sebastes caurinus	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.2 ± 0.1	5.4 ± 2.2	54.0 ± 15.9	0.9 ± 0.9	16.5 ± 9.5
Sebastes chrysomelas	0.1 ± 0.1	0.2 ± 0.1	0.4 ± 0.2	0.1 ± 0.1	17.1 ± 12.5	39.6 ± 21.9	77.6 ± 38.4	16.9 ± 11.5
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.7 ± 0.7	2.3 ± 1.2	1.8 ± 1.0	0.9 ± 0.5
Sebastes mystinus	6.2 ± 2.5	0.8 ± 0.3	1.6 ± 0.7	0.8 ± 0.4	579.7 ± 195.1	44.6 ± 12.2	205.0 ± 78.3	133.2 ± 64.7
Sebastes paucispinis	0.0 ± 0.0	0.9 ± 0.9	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	10.6 ± 8.3	0.0 ± 0.0	0.3 ± 0.3
Sebastes rastrelliger	0.1 ± 0.1	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	35.6 ± 35.6	1.1 ± 1.1	42.1 ± 42.1	0.0 ± 0.0
Sebastes serranoides	0.3 ± 0.1	1.4 ± 0.4	0.3 ± 0.2	1.3 ± 0.4	21.5 ± 12.6	55.9 ± 15.2	24.6 ± 13.0	74.6 ± 27.1
Sebastes serriceps	0.4 ± 0.2	0.2 ± 0.1	0.0 ± 0.0	0.2 ± 0.2	128.1 ± 61.0	73.3 ± 33.3	0.0 ± 0.0	104.7 ± 85.7
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	3.0 ± 0.8	1.7 ± 0.3	1.9 ± 0.4	1.2 ± 0.3	2963.5 ± 849.4	1121.0 ± 256.9	2378.0 ± 645.7	839.3 ± 206.7
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.22. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Point Dume SMCA in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	5.1 ± 1.6	—	11.5 ± 5.3	—	83.0 ± 28.2	—	188.6 ± 113.5	—
Chromis punctipinnis	10.3 ± 7.1	—	0.1 ± 0.1	—	911.9 ± 678.0	—	18.5 ± 15.9	—
Embiotoca jacksoni	2.8 ± 1.3	—	0.6 ± 0.3	—	808.7 ± 313.7	—	162.4 ± 109.7	—
Girella nigricans	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Hypsypops rubicundus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.2 ± 0.2	—
Oxyjulis californica	21.0 ± 5.4	—	4.6 ± 2.2	—	1020.8 ± 239.1	—	223.3 ± 94.9	—
Paralabrax clathratus	9.6 ± 2.6	—	2.6 ± 1.2	—	4738.1 ± 1530.2	—	974.6 ± 396.3	—
Paralabrax nebulifer	2.1 ± 0.9	—	1.1 ± 0.5	—	2153.1 ± 892.8	—	1499.9 ± 687.8	—
Scorpaenichthys marmoratus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes atrovirens	2.1 ± 1.9	—	1.4 ± 1.0	—	661.9 ± 622.4	—	173.7 ± 133.1	—
Sebastes auriculatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	2.5 ± 1.7	—
Sebastes carnatus	0.3 ± 0.2	—	0.0 ± 0.0	—	53.9 ± 53.0	—	0.0 ± 0.0	—
Sebastes caurinus	0.0 ± 0.0	—	0.3 ± 0.2	—	1.6 ± 1.6	—	51.1 ± 40.6	—
Sebastes chrysomelas	0.3 ± 0.2	—	0.0 ± 0.0	—	93.1 ± 65.0	—	0.0 ± 0.0	—
Sebastes miniatus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes mystinus	0.0 ± 0.0	—	0.4 ± 0.4	—	0.0 ± 0.0	—	21.1 ± 14.5	—
Sebastes paucispinis	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes rastrelliger	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes serranoides	0.1 ± 0.1	—	0.6 ± 0.6	—	8.7 ± 8.7	—	7.6 ± 7.6	—
Sebastes serriceps	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Sebastes umbrosus	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—
Semicossyphus pulcher	2.2 ± 0.7	—	1.1 ± 0.5	—	1195.7 ± 455.6	—	948.1 ± 415.0	—
Stereolepis gigas	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—	0.0 ± 0.0	—

Table G.23. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Point Dume SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	5.8 ± 3.3	11.9 ± 3.6	12.8 ± 7.4	17.5 ± 6.5	69.0 ± 40.6	174.7 ± 41.6	220.8 ± 129.0	605.1 ± 267.2
Chromis punctipinnis	23.2 ± 6.9	3.2 ± 2.0	14.9 ± 6.8	5.3 ± 3.9	682.2 ± 185.1	229.4 ± 131.7	710.9 ± 298.4	297.4 ± 184.1
Embiotoca jacksoni	5.3 ± 0.9	8.8 ± 2.9	8.7 ± 2.8	2.4 ± 0.7	1221.2 ± 252.1	2535.6 ± 1054.8	1130.8 ± 278.6	531.9 ± 223.8
Girella nigricans	1.2 ± 0.5	0.0 ± 0.0	1.9 ± 0.8	0.0 ± 0.0	826.6 ± 364.0	0.0 ± 0.0	1098.8 ± 389.9	0.0 ± 0.0
Hypsypops rubicundus	2.4 ± 0.8	0.0 ± 0.0	3.3 ± 1.1	0.1 ± 0.1	748.7 ± 249.1	0.0 ± 0.0	1897.4 ± 718.8	75.5 ± 75.5
Oxyjulis californica	28.3 ± 4.9	48.2 ± 10.4	23.7 ± 5.9	27.5 ± 10.0	805.9 ± 159.9	2273.1 ± 592.7	1212.7 ± 298.9	1354.5 ± 475.4
Paralabrax clathratus	5.6 ± 1.2	7.2 ± 1.4	6.0 ± 1.3	1.9 ± 0.6	2078.5 ± 568.3	3429.2 ± 885.6	2481.3 ± 529.5	1057.8 ± 378.8
Paralabrax nebulifer	0.3 ± 0.2	3.6 ± 2.7	0.6 ± 0.4	0.6 ± 0.3	246.7 ± 136.9	3874.8 ± 3143.3	422.8 ± 189.2	576.0 ± 372.7
Scorpaenichthys marmoratus	0.4 ± 0.2	0.3 ± 0.2	0.6 ± 0.3	0.1 ± 0.1	155.1 ± 69.0	159.1 ± 114.1	361.1 ± 182.0	47.6 ± 47.6
Sebastes atrovirens	0.9 ± 0.3	1.2 ± 0.7	0.9 ± 0.3	1.5 ± 0.6	129.7 ± 56.5	336.4 ± 224.7	176.0 ± 76.7	302.2 ± 113.9
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.3 ± 0.2	0.3 ± 0.3	0.2 ± 0.1	0.6 ± 0.3	28.9 ± 19.5	87.3 ± 87.3	39.1 ± 22.3	113.0 ± 61.3
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.4 ± 0.2	0.0 ± 0.0	0.0 ± 0.0	5.0 ± 5.0	39.4 ± 22.9
Sebastes chrysomelas	0.2 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	37.5 ± 24.3	35.2 ± 35.2	25.0 ± 17.8	19.4 ± 19.4
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.3 ± 0.3	0.0 ± 0.0	0.7 ± 0.4	1.8 ± 1.2	11.8 ± 11.8	15.9 ± 6.7	66.7 ± 60.6
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.1 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	26.0 ± 18.5	7.9 ± 7.9	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.1 ± 0.1	0.6 ± 0.3	0.3 ± 0.1	1.1 ± 0.7	7.2 ± 7.2	22.7 ± 13.6	59.3 ± 35.0	93.2 ± 48.9
Sebastes serriceps	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	22.2 ± 22.2	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	3.8 ± 0.7	2.8 ± 1.3	6.4 ± 1.0	6.2 ± 1.9	1362.7 ± 278.8	1679.2 ± 858.7	3064.7 ± 519.1	3127.3 ± 1049.4
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.24. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Point Vicente SMCA and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	9.7 ± 3.1	1.7 ± 0.8	14.2 ± 4.8	2.1 ± 1.1	94.6 ± 28.9	40.2 ± 23.1	158.8 ± 55.7	12.6 ± 5.1
Chromis punctipinnis	13.8 ± 5.4	5.8 ± 3.6	2.2 ± 1.4	2.8 ± 2.6	1058.1 ± 473.2	143.1 ± 89.2	46.4 ± 33.9	106.3 ± 102.0
Embiotoca jacksoni	3.9 ± 0.7	1.7 ± 0.4	2.3 ± 0.4	0.7 ± 0.2	341.6 ± 82.4	118.5 ± 32.2	173.1 ± 31.0	51.5 ± 16.2
Girella nigricans	1.6 ± 1.4	0.3 ± 0.1	0.3 ± 0.2	1.3 ± 0.8	276.6 ± 213.1	75.0 ± 31.7	115.8 ± 108.0	195.4 ± 89.6
Hypsypops rubicundus	2.0 ± 0.4	0.6 ± 0.2	1.9 ± 0.5	0.8 ± 0.2	451.1 ± 117.9	148.8 ± 39.2	521.9 ± 152.2	118.9 ± 42.1
Oxyjulis californica	20.8 ± 6.6	5.1 ± 1.3	1.6 ± 0.8	2.0 ± 1.0	1220.1 ± 376.1	215.3 ± 60.3	110.0 ± 66.9	36.9 ± 15.8
Paralabrax clathratus	0.5 ± 0.2	1.2 ± 0.2	0.4 ± 0.1	0.5 ± 0.2	109.0 ± 35.2	226.1 ± 49.7	70.2 ± 26.1	65.9 ± 27.5
Paralabrax nebulifer	0.3 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	179.2 ± 104.3	33.3 ± 19.3	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.1 ± 0.1	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	36.3 ± 36.3	0.0 ± 0.0	58.5 ± 41.9	0.0 ± 0.0
Sebastes atrovirens	0.6 ± 0.2	0.5 ± 0.2	0.1 ± 0.1	0.2 ± 0.1	85.2 ± 26.4	64.0 ± 21.7	12.5 ± 12.5	28.9 ± 9.8
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	39.0 ± 39.0	0.0 ± 0.0
Sebastes carnatus	0.3 ± 0.2	0.0 ± 0.0	0.2 ± 0.1	0.0 ± 0.0	30.5 ± 18.6	0.0 ± 0.0	28.0 ± 15.9	7.3 ± 7.3
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.9 ± 0.9	0.0 ± 0.0	1.1 ± 1.1
Sebastes miniatus	1.2 ± 0.6	0.0 ± 0.0	1.2 ± 0.6	0.0 ± 0.0	154.6 ± 70.4	0.0 ± 0.0	239.1 ± 114.4	0.0 ± 0.0
Sebastes mystinus	0.9 ± 0.4	0.7 ± 0.2	0.7 ± 0.3	0.4 ± 0.2	31.1 ± 13.6	20.4 ± 6.7	46.0 ± 20.7	17.6 ± 7.0
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.6 ± 0.6	0.0 ± 0.0	0.0 ± 0.0	7.8 ± 7.8	5.6 ± 5.6	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.7 ± 0.4	0.1 ± 0.0	1.4 ± 0.8	0.1 ± 0.1	27.2 ± 22.1	1.7 ± 1.2	94.3 ± 47.1	2.1 ± 1.4
Sebastes serriceps	0.2 ± 0.1	0.1 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	11.5 ± 9.4	11.9 ± 10.0	14.8 ± 14.8	1.7 ± 1.5
Sebastes umbrosus	0.3 ± 0.1	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	13.6 ± 6.6	0.0 ± 0.0	1.7 ± 1.7	0.0 ± 0.0
Semicossyphus pulcher	2.2 ± 0.4	2.4 ± 0.5	0.8 ± 0.2	1.4 ± 0.2	852.8 ± 302.3	642.9 ± 159.3	241.6 ± 65.8	310.1 ± 69.6
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.25. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Santa Barbara Island SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	0.8 ± 0.4	1.5 ± 1.3	1.7 ± 1.1	0.0 ± 0.0	10.2 ± 4.9	17.8 ± 14.7	11.6 ± 8.9	0.0 ± 0.0
Chromis punctipinnis	35.4 ± 16.8	171.4 ± 38.0	33.7 ± 16.3	321.7 ± 86.6	1602.4 ± 854.9	6289.0 ± 1323.7	2180.4 ± 1035.7	22576.3 ± 5958.6
Embiotoca jacksoni	0.3 ± 0.2	1.5 ± 0.6	0.7 ± 0.3	0.4 ± 0.3	47.2 ± 28.8	94.1 ± 37.9	121.0 ± 98.8	18.1 ± 12.3
Girella nigricans	3.8 ± 1.6	1.7 ± 0.4	0.9 ± 0.6	0.8 ± 0.3	904.9 ± 401.5	451.8 ± 114.1	261.1 ± 178.7	309.1 ± 117.4
Hypsypops rubicundus	1.5 ± 0.6	1.0 ± 0.3	0.5 ± 0.2	0.7 ± 0.4	407.6 ± 161.3	249.2 ± 71.9	118.2 ± 53.8	147.2 ± 80.8
Oxyjulis californica	3.8 ± 2.0	5.2 ± 2.2	3.1 ± 3.0	0.1 ± 0.1	79.4 ± 35.2	150.0 ± 66.0	42.2 ± 28.1	6.0 ± 4.4
Paralabrax clathratus	0.8 ± 0.5	1.4 ± 0.9	0.5 ± 0.3	0.3 ± 0.2	242.1 ± 133.1	797.9 ± 501.9	240.2 ± 147.2	51.1 ± 47.9
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	137.4 ± 110.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	0.1 ± 0.1	0.3 ± 0.2	0.4 ± 0.2	0.1 ± 0.1	8.8 ± 8.8	51.1 ± 29.0	54.4 ± 24.8	33.3 ± 33.3
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	16.8 ± 16.8	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	19.5 ± 13.5	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.3 ± 0.2	2.1 ± 0.9	0.0 ± 0.0	0.1 ± 0.1	12.1 ± 7.8	79.4 ± 32.7	0.0 ± 0.0	17.5 ± 17.5
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.0 ± 0.0	1.2 ± 0.5	0.0 ± 0.0	2.8 ± 1.0	0.0 ± 0.0	107.6 ± 50.2	0.0 ± 0.0	559.1 ± 206.4
Sebastes serriceps	0.0 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	25.4 ± 18.6	16.9 ± 16.9	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	0.7 ± 0.3	2.1 ± 0.4	1.0 ± 0.3	1.9 ± 0.7	435.0 ± 236.6	1067.8 ± 304.6	1315.3 ± 667.0	2065.6 ± 1020.4
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.26. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Scorpion SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	5.5 ± 1.8	6.5 ± 1.9	8.9 ± 2.6	0.0 ± 0.0	77.6 ± 23.0	95.3 ± 26.8	86.2 ± 25.5	0.0 ± 0.0
Chromis punctipinnis	41.5 ± 7.3	27.2 ± 6.1	6.9 ± 1.6	19.0 ± 4.7	2462.4 ± 465.2	1740.1 ± 454.4	374.9 ± 85.6	1230.1 ± 338.8
Embiotoca jacksoni	5.6 ± 0.8	5.2 ± 0.6	4.9 ± 1.0	5.1 ± 0.6	1241.5 ± 187.8	1300.5 ± 160.9	895.7 ± 225.3	917.5 ± 178.6
Girella nigricans	4.4 ± 1.5	2.8 ± 0.8	1.8 ± 0.8	0.7 ± 0.2	2082.5 ± 720.0	1677.4 ± 530.0	1057.1 ± 462.8	442.5 ± 148.8
Hypsypops rubicundus	2.3 ± 0.3	3.1 ± 0.5	2.1 ± 0.4	3.2 ± 0.7	1097.6 ± 175.8	1348.9 ± 208.2	967.3 ± 185.2	1454.0 ± 304.4
Oxyjulis californica	14.1 ± 3.0	14.2 ± 2.8	5.1 ± 1.2	10.2 ± 2.2	734.8 ± 173.1	671.5 ± 129.7	253.2 ± 57.3	462.4 ± 111.1
Paralabrax clathratus	7.3 ± 1.0	5.2 ± 0.6	5.2 ± 0.7	3.8 ± 0.5	4438.1 ± 746.8	2023.1 ± 318.5	3369.1 ± 594.2	1908.1 ± 253.7
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.1 ± 0.1	0.1 ± 0.0	0.1 ± 0.0	31.4 ± 31.4	59.4 ± 32.6	36.1 ± 26.7	114.5 ± 97.6
Sebastes atrovirens	2.3 ± 0.9	4.7 ± 1.2	1.0 ± 0.3	4.1 ± 1.3	213.0 ± 60.8	612.4 ± 165.4	183.3 ± 52.6	714.1 ± 215.5
Sebastes auriculatus	0.0 ± 0.0	0.1 ± 0.0	0.0 ± 0.0	0.3 ± 0.1	22.1 ± 22.1	16.9 ± 13.2	0.0 ± 0.0	48.3 ± 22.5
Sebastes carnatus	0.3 ± 0.1	0.1 ± 0.0	0.2 ± 0.1	0.3 ± 0.1	25.9 ± 21.2	6.3 ± 6.1	41.0 ± 20.0	41.3 ± 17.9
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	11.2 ± 7.1	3.9 ± 1.6	0.0 ± 0.0	22.6 ± 15.8
Sebastes chrysomelas	0.2 ± 0.1	0.2 ± 0.1	0.3 ± 0.2	0.4 ± 0.2	57.2 ± 49.7	9.2 ± 5.4	68.4 ± 38.2	65.8 ± 33.8
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	5.5 ± 5.5
Sebastes mystinus	1.9 ± 0.6	1.6 ± 0.5	0.1 ± 0.1	1.5 ± 0.5	103.1 ± 32.2	103.3 ± 34.7	25.2 ± 9.2	165.4 ± 53.7
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.1 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	0.1 ± 0.0	93.8 ± 68.4	82.7 ± 59.7	0.0 ± 0.0	49.6 ± 34.8
Sebastes serranoides	1.1 ± 0.5	1.0 ± 0.3	0.3 ± 0.1	2.7 ± 1.4	39.1 ± 14.3	53.7 ± 15.7	18.6 ± 8.4	266.9 ± 124.7
Sebastes serriceps	0.5 ± 0.2	0.1 ± 0.1	0.2 ± 0.1	0.3 ± 0.1	122.4 ± 48.6	12.4 ± 7.6	85.7 ± 47.1	59.7 ± 27.9
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	2.9 ± 0.4	2.0 ± 0.3	2.2 ± 0.3	1.9 ± 0.3	2087.8 ± 381.5	682.2 ± 111.1	1678.9 ± 302.1	955.8 ± 164.2
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.27. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at South La Jolla SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	2011		2012		2011		2012	
	MPA	Reference	MPA	Reference	MPA	Reference	MPA	Reference
Brachyistius frenatus	11.8 ± 7.0	1.7 ± 0.9	0.0 ± 0.0	4.6 ± 1.9	83.8 ± 53.9	14.3 ± 8.0	0.0 ± 0.0	47.9 ± 20.1
Chromis punctipinnis	5.7 ± 2.9	11.9 ± 6.2	6.4 ± 3.8	2.4 ± 1.6	243.0 ± 87.2	470.3 ± 268.7	189.4 ± 82.8	75.3 ± 39.3
Embiotoca jacksoni	1.5 ± 0.6	3.1 ± 1.7	0.4 ± 0.2	0.8 ± 0.5	111.8 ± 52.5	508.7 ± 292.8	39.9 ± 26.5	53.5 ± 44.2
Girella nigricans	4.2 ± 4.2	0.3 ± 0.2	2.5 ± 1.9	0.8 ± 0.5	1699.2 ± 1699.2	226.8 ± 159.9	1111.8 ± 966.2	269.5 ± 171.2
Hypsypops rubicundus	0.9 ± 0.5	0.1 ± 0.1	0.7 ± 0.5	0.1 ± 0.1	206.9 ± 115.4	25.0 ± 25.0	175.3 ± 126.6	25.0 ± 25.0
Oxyjulis californica	15.3 ± 7.6	7.3 ± 4.7	5.2 ± 5.2	9.6 ± 5.3	423.3 ± 107.2	152.0 ± 92.8	101.2 ± 91.6	321.4 ± 191.8
Paralabrax clathratus	2.9 ± 0.9	1.2 ± 0.4	7.0 ± 3.1	2.3 ± 0.5	972.4 ± 370.0	463.5 ± 238.7	3032.2 ± 1943.8	525.4 ± 139.9
Paralabrax nebulifer	0.0 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	38.7 ± 38.7	22.4 ± 22.4	0.0 ± 0.0
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	1.2 ± 0.7	1.0 ± 0.6	0.7 ± 0.4	0.5 ± 0.4	245.8 ± 119.9	87.4 ± 47.1	168.2 ± 106.8	70.2 ± 57.7
Sebastes auriculatus	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	16.8 ± 16.8	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.1 ± 0.1	0.5 ± 0.3	0.1 ± 0.1	0.0 ± 0.0	29.4 ± 29.4	85.3 ± 46.3	16.1 ± 16.1	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	6.2 ± 6.2	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	2.7 ± 2.7	5.4 ± 5.4
Sebastes paucispinis	0.0 ± 0.0	0.2 ± 0.2	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	31.9 ± 31.9	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.1 ± 0.1	1.9 ± 0.9	0.5 ± 0.4	0.3 ± 0.2	2.2 ± 2.2	50.8 ± 24.7	23.6 ± 16.3	32.4 ± 23.5
Sebastes serriceps	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	29.6 ± 29.6	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	0.9 ± 0.6	0.4 ± 0.3	1.5 ± 0.6	0.6 ± 0.5	470.5 ± 375.8	232.0 ± 162.2	1046.2 ± 497.7	142.4 ± 107.2
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.28. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at South Point SMR and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	1.5 ± 0.4	1.0 ± 0.4	6.9 ± 1.9	1.5 ± 0.5	13.2 ± 3.7	10.6 ± 5.0	86.9 ± 24.6	16.5 ± 6.1
Chromis punctipinnis	15.3 ± 8.9	1.0 ± 0.6	7.6 ± 2.9	1.4 ± 0.5	1625.7 ± 1007.7	143.2 ± 95.0	948.9 ± 461.5	173.4 ± 63.6
Embiotoca jacksoni	1.4 ± 0.4	0.8 ± 0.3	2.4 ± 0.4	0.9 ± 0.2	524.2 ± 145.9	391.4 ± 171.6	667.5 ± 156.0	239.9 ± 84.1
Girella nigricans	0.3 ± 0.2	0.6 ± 0.5	0.9 ± 0.4	0.2 ± 0.1	120.8 ± 69.0	436.4 ± 332.1	663.2 ± 289.9	182.0 ± 133.1
Hypsypops rubicundus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	2.2 ± 2.2
Oxyjulis californica	13.7 ± 4.3	6.8 ± 2.2	18.8 ± 4.8	4.0 ± 1.5	624.1 ± 187.8	248.9 ± 78.8	1206.5 ± 335.5	178.8 ± 67.7
Paralabrax clathratus	0.3 ± 0.2	0.2 ± 0.1	0.6 ± 0.2	0.1 ± 0.1	104.0 ± 72.1	120.1 ± 66.1	728.4 ± 406.0	18.8 ± 12.4
Paralabrax nebulifer	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	0.1 ± 0.1	0.0 ± 0.0	0.2 ± 0.1	0.0 ± 0.0	101.3 ± 70.2	0.0 ± 0.0	117.9 ± 82.8	50.2 ± 50.2
Sebastes atrovirens	8.5 ± 2.1	3.9 ± 1.0	4.7 ± 1.1	2.7 ± 0.8	3347.0 ± 833.1	959.8 ± 331.0	1449.1 ± 391.2	838.9 ± 241.7
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	28.1 ± 28.1	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.2 ± 0.1	0.1 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	47.9 ± 26.6	13.9 ± 13.9	22.2 ± 13.0
Sebastes caurinus	0.1 ± 0.1	0.1 ± 0.0	0.3 ± 0.2	0.1 ± 0.0	224.4 ± 159.0	14.8 ± 12.9	348.8 ± 199.5	3.4 ± 2.4
Sebastes chrysomelas	0.1 ± 0.1	0.2 ± 0.1	0.2 ± 0.1	0.3 ± 0.2	36.2 ± 36.2	73.0 ± 35.5	87.7 ± 49.2	132.2 ± 71.2
Sebastes miniatus	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.1 ± 0.0	0.0 ± 0.0	177.2 ± 109.3	0.0 ± 0.0	92.7 ± 65.2
Sebastes mystinus	17.5 ± 10.1	5.0 ± 2.0	8.6 ± 2.8	5.9 ± 2.6	3673.0 ± 2082.0	570.8 ± 258.4	1991.2 ± 901.7	1219.1 ± 484.7
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	21.1 ± 21.1	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	6.9 ± 2.5	1.4 ± 0.5	4.0 ± 1.1	0.7 ± 0.2	3408.5 ± 1388.6	294.0 ± 123.6	1582.5 ± 399.3	267.5 ± 85.4
Sebastes serriceps	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	19.7 ± 19.7	12.5 ± 12.5
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	4.0 ± 0.9	0.6 ± 0.2	2.0 ± 0.4	1.2 ± 0.3	6097.7 ± 1604.0	736.7 ± 274.2	3219.7 ± 782.3	1123.8 ± 279.0
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.29. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Swami's SMCA and reference sites in 2011 and 2012.

	Density				Biomass Density			
Fish Species	**2011**		**2012**		**2011**		**2012**	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	11.0 ± 5.9	6.7 ± 4.7	1.1 ± 0.5	1.7 ± 1.1	118.1 ± 61.5	122.8 ± 95.6	7.5 ± 2.0	6.3 ± 4.4
Chromis punctipinnis	0.0 ± 0.0	0.1 ± 0.1	0.1 ± 0.1	0.0 ± 0.0	7.1 ± 7.1	6.7 ± 6.7	27.8 ± 14.2	4.1 ± 4.1
Embiotoca jacksoni	1.5 ± 0.7	1.1 ± 0.6	0.1 ± 0.1	0.0 ± 0.0	85.6 ± 45.7	115.1 ± 64.1	22.6 ± 21.5	0.7 ± 0.7
Girella nigricans	0.0 ± 0.0	4.0 ± 3.7	0.8 ± 0.8	0.0 ± 0.0	0.0 ± 0.0	830.5 ± 765.2	604.7 ± 604.7	0.0 ± 0.0
Hypsypops rubicundus	0.0 ± 0.0	1.2 ± 0.8	2.5 ± 1.0	0.0 ± 0.0	0.0 ± 0.0	236.4 ± 180.7	590.3 ± 275.3	0.0 ± 0.0
Oxyjulis californica	1.2 ± 0.8	0.7 ± 0.4	0.0 ± 0.0	1.1 ± 0.9	35.9 ± 23.8	43.3 ± 22.0	33.9 ± 16.3	44.7 ± 35.2
Paralabrax clathratus	2.8 ± 1.1	4.3 ± 1.2	9.4 ± 2.6	1.0 ± 0.6	291.2 ± 167.0	558.2 ± 261.1	583.4 ± 130.6	56.1 ± 27.6
Paralabrax nebulifer	0.4 ± 0.3	0.6 ± 0.2	2.5 ± 1.8	0.1 ± 0.1	111.3 ± 75.3	184.6 ± 81.2	498.5 ± 351.5	3.2 ± 3.2
Scorpaenichthys marmoratus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	17.6 ± 17.6	0.0 ± 0.0
Sebastes auriculatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes serriceps	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	0.1 ± 0.1	1.0 ± 0.5	1.5 ± 0.6	0.0 ± 0.0	128.2 ± 128.2	579.4 ± 361.6	560.5 ± 371.3	0.0 ± 0.0
Stereolepis gigas	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0

Table G.30. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at SWAT 1 and reference sites in 2012.

	Density				Biomass Density			
Fish Species	2011		2012		2011		2012	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	—	—	7.9 ± 3.8	0.4 ± 0.2	—	—	56.4 ± 30.8	4.1 ± 1.9
Chromis punctipinnis	—	—	18.6 ± 10.4	1.0 ± 0.5	—	—	1243.6 ± 361.1	65.2 ± 31.8
Embiotoca jacksoni	—	—	0.3 ± 0.2	0.4 ± 0.2	—	—	10.9 ± 8.1	29.8 ± 17.1
Girella nigricans	—	—	7.9 ± 6.1	2.0 ± 0.9	—	—	2292.6 ± 1826.0	630.7 ± 378.0
Hypsypops rubicundus	—	—	3.2 ± 0.9	1.4 ± 0.6	—	—	531.1 ± 150.6	231.6 ± 85.8
Oxyjulis californica	—	—	4.6 ± 1.7	9.2 ± 4.4	—	—	131.2 ± 41.0	204.5 ± 76.7
Paralabrax clathratus	—	—	5.3 ± 1.3	7.2 ± 1.5	—	—	591.7 ± 128.5	1532.8 ± 390.6
Paralabrax nebulifer	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	—	—	1.2 ± 0.5	0.0 ± 0.0	—	—	107.4 ± 39.5	0.0 ± 0.0
Sebastes auriculatus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	—	—	0.3 ± 0.3	0.0 ± 0.0	—	—	262.2 ± 262.2	0.0 ± 0.0
Sebastes rastrelliger	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes serranoides	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes serriceps	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	—	—	5.3 ± 1.4	5.2 ± 1.1	—	—	2269.2 ± 514.9	2348.0 ± 540.9
Stereolepis gigas	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0

Table G.31. Mean fish numerical densities (#/100m^2) and biomass densities (g/100m^2) (± standard error) of the 23 focal fish species at Wilson Cove and reference sites in 2012.

	Density				Biomass Density			
Fish Species	2011		2012		2011		2012	
	MPA	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**	**MPA**	**Reference**
Brachyistius frenatus	—	—	2.5 ± 0.8	3.4 ± 1.2	—	—	17.8 ± 7.1	55.0 ± 20.1
Chromis punctipinnis	—	—	7.4 ± 4.4	29.2 ± 16.0	—	—	731.0 ± 378.0	849.1 ± 318.7
Embiotoca jacksoni	—	—	0.0 ± 0.0	0.6 ± 0.3	—	—	0.0 ± 0.0	13.5 ± 6.5
Girella nigricans	—	—	1.7 ± 0.6	3.3 ± 0.8	—	—	420.2 ± 177.2	833.8 ± 234.2
Hypsypops rubicundus	—	—	1.7 ± 0.5	9.1 ± 1.4	—	—	302.0 ± 71.0	1088.8 ± 231.3
Oxyjulis californica	—	—	9.7 ± 4.4	1.4 ± 0.3	—	—	333.6 ± 136.2	121.5 ± 23.0
Paralabrax clathratus	—	—	3.9 ± 1.2	23.0 ± 3.8	—	—	1028.6 ± 452.8	4081.2 ± 665.9
Paralabrax nebulifer	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Scorpaenichthys marmoratus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes atrovirens	—	—	0.0 ± 0.0	0.1 ± 0.1	—	—	0.0 ± 0.0	10.5 ± 10.5
Sebastes auriculatus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes carnatus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes caurinus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes chrysomelas	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes miniatus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes mystinus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes paucispinis	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes rastrelliger	—	—	0.0 ± 0.0	0.1 ± 0.1	—	—	0.0 ± 0.0	15.3 ± 15.3
Sebastes serranoides	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes serriceps	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Sebastes umbrosus	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0
Semicossyphus pulcher	—	—	5.7 ± 0.8	3.9 ± 1.0	—	—	1823.3 ± 463.7	953.5 ± 253.8
Stereolepis gigas	—	—	0.0 ± 0.0	0.0 ± 0.0	—	—	0.0 ± 0.0	0.0 ± 0.0

Appendix H

Table H.1. Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1980	1981	1982	1983	1984	1986	1987	1988
Abalone Cove SMCA	720	271.3	201.6	99.3	122.2	57.5	64.1	44.6	49.4
Anacapa Island SMCA	684	166.1	92.3	99.1	73.0	37.4	29.3	9.8	16.3
Anacapa Island SMR	684	166.1	92.3	99.1	73.0	37.4	29.3	9.8	16.3
Arrow Point to Lion Head Point SMCA	761	71.4	41.2	57.5	34.9	22.5	32.9	19.2	22.8
Arrow Point to Lion Head Point SMCA	762	29.1	49.5	34.9	30.9	9.4	31.5	16.0	19.4
Begg Rock SMR	768	1.1	0.7	0.1	0.0	0.1	0.0	0.0	0.0
Begg Rock SMR	769	0.2	2.9	1.3	1.2	0.7	0.6	0.8	1.2
Begg Rock SMR	814	127.8	93.2	12.6	11.9	128.6	282.0	323.6	77.3
Begg Rock SMR	815	8.9	184.4	274.0	30.3	1.0	0.0	0.1	0.3
Bird Rock SMCA	741	14.3	2.0	0.7	0.1	0.1	1.1	0.1	0.5
Bird Rock SMCA	761	71.4	41.2	57.5	34.9	22.5	32.9	19.2	22.8
Blue Cavern SMCA	761	71.4	41.2	57.5	34.9	22.5	32.9	19.2	22.8
Cabrillo SMR	860	974.2	1082.6	1138.2	634.2	203.9	295.2	91.4	323.5
Cabrillo SMR	878	20.3	46.4	50.6	97.5	66.2	24.1	15.3	22.9
Campus Point SMCA	654	47.8	64.1	39.6	25.2	19.8	18.6	62.5	27.1
Carrington Point SMR	688	94.7	443.1	29.5	24.7	17.5	20.5	5.6	44.0
Casino Point SMCA	760	7.1	9.0	3.8	18.3	2.1	10.8	19.1	9.3
Cat Harbor SMCA	762	29.1	49.5	34.9	30.9	9.4	31.5	16.0	19.4
Crystal Cove SMCA	737	9.8	16.8	9.9	14.8	5.4	4.7	3.5	5.5
Crystal Cove SMCA	738	42.9	52.3	34.9	25.7	13.3	23.7	33.0	55.1
Dana Point SMCA	737	9.8	16.8	9.9	14.8	5.4	4.7	3.5	5.5
Dana Point SMCA	757	25.3	107.6	71.1	91.2	50.8	14.4	12.9	20.4
Farnsworth Offshore SMCA	761	71.4	41.2	57.5	34.9	22.5	32.9	19.2	22.8
Farnsworth Offshore SMCA	762	29.1	49.5	34.9	30.9	9.4	31.5	16.0	19.4
Farnsworth Offshore SMCA	807	14.7	18.5	20.7	5.2	5.4	6.8	6.3	19.2
Farnsworth Offshore SMCA	808	0.1	-	-	0.0	0.0	0.4	0.1	1.3
Farnsworth Onshore SMCA	761	71.4	41.2	57.5	34.9	22.5	32.9	19.2	22.8
Farnsworth Onshore SMCA	807	14.7	18.5	20.7	5.2	5.4	6.8	6.3	19.2

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1989	1990	1991	1992	1993	1994	1995
Abalone Cove SMCA	720	54.9	104.0	110.5	101.8	89.1	117.7	187.1
Anacapa Island SMCA	684	12.1	27.8	37.6	44.7	37.3	47.7	52.9
Anacapa Island SMR	684	12.1	27.8	37.6	44.7	37.3	47.7	52.9
Arrow Point to Lion Head Point SMCA	761	33.6	20.9	28.9	30.1	25.0	28.7	27.1
Arrow Point to Lion Head Point SMCA	762	39.6	26.4	24.1	52.1	32.4	22.9	33.0
Begg Rock SMR	768	0.1	0.4	1.3	1.4	7.5	12.9	0.7
Begg Rock SMR	769	0.5	0.2	0.6	4.1	1.6	2.3	12.8
Begg Rock SMR	814	157.8	366.5	537.6	403.6	470.5	388.3	806.5
Begg Rock SMR	815	0.1	3.8	0.4	1.0	0.4	3.3	7.1
Bird Rock SMCA	741	0.1	0.2	0.5	1.3	4.9	13.5	12.1
Bird Rock SMCA	761	33.6	20.9	28.9	30.1	25.0	28.7	27.1
Blue Cavern SMCA	761	33.6	20.9	28.9	30.1	25.0	28.7	27.1
Cabrillo SMR	860	504.5	641.0	701.8	621.9	728.8	768.8	716.2
Cabrillo SMR	878	33.8	45.6	19.5	21.3	23.4	30.8	18.1
Campus Point SMCA	654	29.2	26.5	52.9	85.4	51.5	50.5	83.9
Carrington Point SMR	688	101.3	663.1	1011.4	891.0	754.1	447.5	241.0
Casino Point SMCA	760	17.1	8.9	10.7	15.8	26.9	6.0	5.6
Cat Harbor SMCA	762	39.6	26.4	24.1	52.1	32.4	22.9	33.0
Crystal Cove SMCA	737	4.6	4.2	12.3	5.0	4.0	4.0	5.7
Crystal Cove SMCA	738	32.8	33.3	52.5	13.5	28.9	38.6	49.0
Dana Point SMCA	737	4.6	4.2	12.3	5.0	4.0	4.0	5.7
Dana Point SMCA	757	53.0	113.8	91.8	114.7	76.0	66.4	67.0
Farnsworth Offshore SMCA	761	33.6	20.9	28.9	30.1	25.0	28.7	27.1
Farnsworth Offshore SMCA	762	39.6	26.4	24.1	52.1	32.4	22.9	33.0
Farnsworth Offshore SMCA	807	12.8	21.0	19.1	12.9	8.4	11.2	21.9
Farnsworth Offshore SMCA	808	0.5	0.1	0.7	0.2	0.4	0.9	2.3
Farnsworth Onshore SMCA	761	33.6	20.9	28.9	30.1	25.0	28.7	27.1
Farnsworth Onshore SMCA	807	12.8	21.0	19.1	12.9	8.4	11.2	21.9

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1996	1997	1998	1999	2000	2001	2002
Abalone Cove SMCA	720	149.7	121.7	82.0	130.5	152.4	166.3	215.5
Anacapa Island SMCA	684	31.0	23.8	35.8	26.0	30.5	31.6	21.9
Anacapa Island SMR	684	31.0	23.8	35.8	26.0	30.5	31.6	21.9
Arrow Point to Lion Head Point SMCA	761	32.0	52.8	11.4	19.0	68.5	58.9	35.0
Arrow Point to Lion Head Point SMCA	762	48.7	65.7	18.5	113.1	155.4	154.0	60.4
Begg Rock SMR	768	0.2	0.9	0.3	1.2	0.9	0.2	2.4
Begg Rock SMR	769	1.6	0.3	1.2	0.4	1.2	0.5	0.2
Begg Rock SMR	814	343.6	411.0	343.1	622.9	232.4	95.8	121.5
Begg Rock SMR	815	6.7	3.8	3.1	0.0	2.2	2.6	3.9
Bird Rock SMCA	741	9.0	4.4	1.2	0.9	3.4	20.2	4.0
Bird Rock SMCA	761	32.0	52.8	11.4	19.0	68.5	58.9	35.0
Blue Cavern SMCA	761	32.0	52.8	11.4	19.0	68.5	58.9	35.0
Cabrillo SMR	860	769.9	523.1	291.9	291.4	417.5	483.7	566.0
Cabrillo SMR	878	46.7	31.5	26.4	42.0	70.0	74.1	91.4
Campus Point SMCA	654	76.5	95.3	46.3	21.1	11.8	16.2	8.0
Carrington Point SMR	688	354.4	445.7	270.9	317.4	151.6	150.8	187.8
Casino Point SMCA	760	9.0	6.0	3.0	6.7	6.0	18.3	7.8
Cat Harbor SMCA	762	48.7	65.7	18.5	113.1	155.4	154.0	60.4
Crystal Cove SMCA	737	12.0	23.1	7.9	6.7	17.7	22.0	13.4
Crystal Cove SMCA	738	87.3	59.4	36.6	45.1	75.7	73.5	83.5
Dana Point SMCA	737	12.0	23.1	7.9	6.7	17.7	22.0	13.4
Dana Point SMCA	757	88.6	83.3	38.8	21.9	91.2	97.7	84.8
Farnsworth Offshore SMCA	761	32.0	52.8	11.4	19.0	68.5	58.9	35.0
Farnsworth Offshore SMCA	762	48.7	65.7	18.5	113.1	155.4	154.0	60.4
Farnsworth Offshore SMCA	807	19.0	29.0	7.9	35.3	30.4	53.5	27.4
Farnsworth Offshore SMCA	808	0.3	0.4	0.1	0.7	0.1	1.6	0.7
Farnsworth Onshore SMCA	761	32.0	52.8	11.4	19.0	68.5	58.9	35.0
Farnsworth Onshore SMCA	807	19.0	29.0	7.9	35.3	30.4	53.5	27.4

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	2003	2004	2005	2006	2007	2008	2009	Total (1980-2009)
Abalone Cove SMCA	720	161.9	164.4	88.8	58.9	73.6	156.0	107.5	3504.5
Anacapa Island SMCA	684	27.6	31.2	17.0	19.7	20.3	23.3	20.3	1143.2
Anacapa Island SMR	684	27.6	31.2	17.0	19.7	20.3	23.3	20.3	1143.2
Arrow Point to Lion Head Point SMCA	761	44.6	35.2	36.0	46.5	32.2	35.4	28.3	1032.5
Arrow Point to Lion Head Point SMCA	762	67.8	53.3	47.5	44.9	41.5	30.8	33.1	1386.0
Begg Rock SMR	768	0.6	0.8	0.6	1.6	0.1	0.9	0.8	38.0
Begg Rock SMR	769	1.4	0.6	-	0.1	0.0	0.0	0.1	38.7
Begg Rock SMR	814	98.9	32.4	59.0	142.4	117.6	39.7	24.3	6872.6
Begg Rock SMR	815	0.5	0.0	1.3	-	0.1	0.3	-	539.5
Bird Rock SMCA	741	2.0	0.9	0.1	1.4	0.3	0.0	0.3	99.9
Bird Rock SMCA	761	44.6	35.2	36.0	46.5	32.2	35.4	28.3	1032.5
Blue Cavern SMCA	761	44.6	35.2	36.0	46.5	32.2	35.4	28.3	1032.5
Cabrillo SMR	860	507.5	527.1	448.1	505.6	413.1	459.5	454.9	16085.5
Cabrillo SMR	878	86.4	58.7	61.3	59.4	28.3	37.7	21.6	1271.3
Campus Point SMCA	654	23.8	34.9	42.9	49.3	16.6	13.1	33.0	1173.6
Carrington Point SMR	688	309.8	295.4	398.9	462.0	326.0	119.5	176.3	8755.4
Casino Point SMCA	760	10.2	5.4	14.2	17.1	18.1	16.3	8.1	317.0
Cat Harbor SMCA	762	67.8	53.3	47.5	44.9	41.5	30.8	33.1	1386.0
Crystal Cove SMCA	737	9.2	14.5	9.1	8.7	13.3	12.4	11.4	291.5
Crystal Cove SMCA	738	71.9	85.4	49.5	66.5	47.2	58.9	54.2	1424.1
Dana Point SMCA	737	9.2	14.5	9.1	8.7	13.3	12.4	11.4	291.5
Dana Point SMCA	757	74.2	111.6	61.8	53.4	61.4	89.0	74.3	2008.4
Farnsworth Offshore SMCA	761	44.6	35.2	36.0	46.5	32.2	35.4	28.3	1032.5
Farnsworth Offshore SMCA	762	67.8	53.3	47.5	44.9	41.5	30.8	33.1	1386.0
Farnsworth Offshore SMCA	807	33.9	9.9	12.7	10.3	10.4	15.5	14.1	513.2
Farnsworth Offshore SMCA	808	0.0	0.0	0.3	0.2	0.0	0.1	-	11.6
Farnsworth Onshore SMCA	761	44.6	35.2	36.0	46.5	32.2	35.4	28.3	1032.5
Farnsworth Onshore SMCA	807	33.9	9.9	12.7	10.3	10.4	15.5	14.1	513.2

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1980	1981	1982	1983	1984	1986	1987	1988
Footprint SMR	707	3.6	6.8	4.7	17.3	11.5	0.2	0.7	0.7
Footprint SMR	708	57.9	80.2	195.9	604.6	538.2	16.5	6.6	8.5
Gull Island SMR	709	433.1	200.4	117.8	99.2	22.8	8.7	4.8	1.1
Gull Island SMR	710	798.5	636.9	587.2	392.9	325.0	546.7	201.5	88.4
Harris Point SMR	689	323.0	1510.3	1473.8	1141.9	1141.9	288.7	305.1	376.1
Harris Point SMR	690	2759.3	2577.4	1562.4	1890.1	1189.9	1072.8	398.9	386.5
Judith Rock SMR	690	2759.3	2577.4	1562.4	1890.1	1189.9	1072.8	398.9	386.5
Judith Rock SMR	713	1.3	11.4	0.3	0.5	0.3	17.8	8.4	0.6
Kashtayit SMCA	656	47.2	94.9	149.3	22.7	26.0	104.1	134.9	81.6
Laguna Beach SMCA	737	9.8	16.8	9.9	14.8	5.4	4.7	3.5	5.5
Laguna Beach SMR	737	9.8	16.8	9.9	14.8	5.4	4.7	3.5	5.5
Long Point SMR	761	71.4	41.2	57.5	34.9	22.5	32.9	19.2	22.8
Lover's Cove SMCA	760	7.1	9.0	3.8	18.3	2.1	10.8	19.1	9.3
Matlahuayl SMR	842	14.2	15.1	10.7	14.6	7.3	11.5	7.1	9.5
Naples SMCA	654	47.8	64.1	39.6	25.2	19.8	18.6	62.5	27.1
Painted Cave SMCA	687	133.9	116.6	55.7	22.7	24.8	15.1	5.9	6.4
Point Conception SMR	657	405.5	335.4	212.3	179.9	191.3	103.2	50.6	49.3
Point Conception SMR	658	2.8	12.5	21.6	0.1	1.2	1.5	1.8	0.3
Point Dume SMCA	680	29.0	296.4	259.1	202.2	24.7	81.9	18.1	8.0
Point Dume SMCA	681	14.8	25.0	192.5	228.3	123.0	9.2	7.6	9.7
Point Dume SMCA	703	1.8	14.1	4.4	0.3	0.9	6.1	0.6	0.5
Point Dume SMCA	704	1.7	4.8	0.1	1.3	0.8	0.5	1.9	0.0
Point Dume SMR	680	29.0	296.4	259.1	202.2	24.7	81.9	18.1	8.0
Point Dume SMR	703	1.8	14.1	4.4	0.3	0.9	6.1	0.6	0.5

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1989	1990	1991	1992	1993	1994	1995
Footprint SMR	707	2.2	5.1	52.1	45.4	46.8	44.6	31.5
Footprint SMR	708	13.3	29.4	79.6	181.0	145.1	258.9	303.4
Gull Island SMR	709	6.7	35.8	60.3	31.4	81.3	144.5	53.8
Gull Island SMR	710	101.8	72.1	185.6	144.7	124.9	191.7	101.7
Harris Point SMR	689	237.4	323.5	999.4	618.7	815.3	670.4	192.5
Harris Point SMR	690	541.1	675.9	1101.2	957.4	1261.7	1172.3	1123.2
Judith Rock SMR	690	541.1	675.9	1101.2	957.4	1261.7	1172.3	1123.2
Judith Rock SMR	713	4.2	0.4	4.8	9.0	19.2	5.6	4.5
Kashtayit SMCA	656	141.1	194.6	112.2	139.3	69.7	48.7	40.4
Laguna Beach SMCA	737	4.6	4.2	12.3	5.0	4.0	4.0	5.7
Laguna Beach SMR	737	4.6	4.2	12.3	5.0	4.0	4.0	5.7
Long Point SMR	761	33.6	20.9	28.9	30.1	25.0	28.7	27.1
Lover's Cove SMCA	760	17.1	8.9	10.7	15.8	26.9	6.0	5.6
Matlahuayl SMR	842	5.2	11.8	12.8	2.8	2.5	2.2	8.0
Naples SMCA	654	29.2	26.5	52.9	85.4	51.5	50.5	83.9
Painted Cave SMCA	687	21.7	57.4	118.2	190.4	150.6	127.2	111.2
Point Conception SMR	657	62.1	66.6	52.7	72.1	77.8	83.2	67.4
Point Conception SMR	658	3.5	2.7	3.8	33.5	8.4	15.2	5.8
Point Dume SMCA	680	221.1	25.1	23.6	37.9	46.6	109.0	64.3
Point Dume SMCA	681	18.0	23.4	49.4	124.6	115.8	110.4	89.0
Point Dume SMCA	703	1.3	2.9	1.2	2.3	1.1	4.8	5.3
Point Dume SMCA	704	0.2	0.5	8.9	5.2	4.5	1.4	2.4
Point Dume SMR	680	221.1	25.1	23.6	37.9	46.6	109.0	64.3
Point Dume SMR	703	1.3	2.9	1.2	2.3	1.1	4.8	5.3

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1996	1997	1998	1999	2000	2001	2002
Footprint SMR	707	42.5	17.6	6.8	15.7	26.1	10.3	14.6
Footprint SMR	708	253.7	181.4	134.5	156.0	225.2	163.3	116.0
Gull Island SMR	709	58.6	41.5	21.8	15.9	32.8	20.7	56.8
Gull Island SMR	710	108.8	124.9	70.8	183.6	125.2	143.5	258.7
Harris Point SMR	689	281.4	250.0	317.4	220.1	84.0	55.0	95.9
Harris Point SMR	690	1215.3	870.4	569.1	832.1	470.8	395.0	390.4
Judith Rock SMR	690	1215.3	870.4	569.1	832.1	470.8	395.0	390.4
Judith Rock SMR	713	10.2	35.9	35.4	22.6	43.0	42.0	45.0
Kashtayit SMCA	656	47.6	45.6	29.8	35.3	34.3	17.0	14.2
Laguna Beach SMCA	737	12.0	23.1	7.9	6.7	17.7	22.0	13.4
Laguna Beach SMR	737	12.0	23.1	7.9	6.7	17.7	22.0	13.4
Long Point SMR	761	32.0	52.8	11.4	19.0	68.5	58.9	35.0
Lover's Cove SMCA	760	9.0	6.0	3.0	6.7	6.0	18.3	7.8
Matlahuayl SMR	842	7.8	11.1	4.6	12.4	26.3	26.5	18.5
Naples SMCA	654	76.5	95.3	46.3	21.1	11.8	16.2	8.0
Painted Cave SMCA	687	69.5	115.4	97.0	184.3	74.0	29.0	118.9
Point Conception SMR	657	62.7	108.6	95.6	45.2	26.9	45.9	58.6
Point Conception SMR	658	4.2	2.1	3.8	3.7	0.9	2.9	10.3
Point Dume SMCA	680	75.4	47.4	27.1	30.1	79.4	79.8	78.0
Point Dume SMCA	681	93.8	93.2	17.6	68.7	70.8	113.3	94.0
Point Dume SMCA	703	4.6	2.1	1.4	0.6	1.3	1.2	0.7
Point Dume SMCA	704	1.1	2.6	2.5	1.6	1.0	2.5	0.9
Point Dume SMR	680	75.4	47.4	27.1	30.1	79.4	79.8	78.0
Point Dume SMR	703	4.6	2.1	1.4	0.6	1.3	1.2	0.7

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	2003	2004	2005	2006	2007	2008	2009	Total (1980-2009)
Footprint SMR	707	31.8	34.3	45.9	62.0	20.0	28.1	23.4	652.2
Footprint SMR	708	294.8	240.5	282.2	377.8	275.4	483.6	408.9	6112.5
Gull Island SMR	709	49.3	23.3	32.7	48.1	26.6	32.8	88.8	1851.1
Gull Island SMR	710	218.7	122.3	100.5	109.3	129.1	87.0	124.2	6406.2
Harris Point SMR	689	221.2	463.7	872.6	559.8	826.2	182.4	348.3	15196.0
Harris Point SMR	690	576.9	990.2	939.3	979.3	907.4	880.4	953.3	29639.9
Judith Rock SMR	690	576.9	990.2	939.3	979.3	907.4	880.4	953.3	29639.9
Judith Rock SMR	713	48.1	47.0	50.6	53.8	33.8	10.9	7.6	574.3
Kashtayit SMCA	656	16.5	6.1	13.3	24.6	9.7	3.7	1.9	1706.2
Laguna Beach SMCA	737	9.2	14.5	9.1	8.7	13.3	12.4	11.4	291.5
Laguna Beach SMR	737	9.2	14.5	9.1	8.7	13.3	12.4	11.4	291.5
Long Point SMR	761	44.6	35.2	36.0	46.5	32.2	35.4	28.3	1032.5
Lover's Cove SMCA	760	10.2	5.4	14.2	17.1	18.1	16.3	8.1	317.0
Matlahuayl SMR	842	12.3	18.4	18.0	12.8	12.0	11.2	8.8	336.0
Naples SMCA	654	23.8	34.9	42.9	49.3	16.6	13.1	33.0	1173.6
Painted Cave SMCA	687	239.4	313.5	205.5	192.8	257.8	169.6	197.2	3421.8
Point Conception SMR	657	34.5	31.4	24.9	11.1	6.9	7.8	1.9	2571.4
Point Conception SMR	658	3.3	2.1	1.9	5.3	11.2	23.1	26.7	216.2
Point Dume SMCA	680	52.4	61.1	35.8	24.1	45.4	66.3	67.1	2216.3
Point Dume SMCA	681	105.0	123.7	55.4	38.4	118.1	174.9	157.2	2464.8
Point Dume SMCA	703	1.0	1.0	0.4	2.4	0.4	0.3	0.2	65.3
Point Dume SMCA	704	1.5	2.1	5.5	1.9	0.9	0.3	0.2	58.9
Point Dume SMR	680	52.4	61.1	35.8	24.1	45.4	66.3	67.1	2216.3
Point Dume SMR	703	1.0	1.0	0.4	2.4	0.4	0.3	0.2	65.3

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1980	1981	1982	1983	1984	1986	1987	1988
Point Vicente SMCA	720	271.3	201.6	99.3	122.2	57.5	64.1	44.6	49.4
Richardson Rock SMR	690	2759.3	2577.4	1562.4	1890.1	1189.9	1072.8	398.9	386.5
Richardson Rock SMR	691	2.7	4.2	4.2	0.7	0.5	1.2	1.7	1.5
SWAT 1	829	58.8	37.7	23.0	22.6	16.4	33.1	4.5	11.9
SWAT 1	830	-	-	0.4	0.1	0.0	-	0.6	-
Wilson Cove	828	-	0.3	0.0	0.0	0.0	-	0.1	-
Wilson Cove	829	58.8	37.7	23.0	22.6	16.4	33.1	4.5	11.9
Wilson Cove	849	41.0	12.2	13.2	13.4	8.3	13.8	22.5	13.0
Wilson Cove	850	161.3	212.5	178.1	97.7	50.2	71.6	93.9	335.8
San Diego-Scripps Coastal SMCA	842	14.2	15.1	10.7	14.6	7.3	11.5	7.1	9.5
Santa Barbara Island SMR	764	0.2	4.5	0.1	0.4	0.1	0.2	0.5	0.1
Santa Barbara Island SMR	765	108.0	161.6	37.7	39.1	7.9	10.9	26.6	35.4
Scorpion SMR	685	90.7	70.3	21.3	26.0	23.5	31.9	5.8	7.2
Skunk Point SMR	710	798.5	636.9	587.2	392.9	325.0	546.7	201.5	88.4
South La Jolla SMCA	860	974.2	1082.6	1138.2	634.2	203.9	295.2	91.4	323.5
South La Jolla SMCA	861	17.6	19.0	13.1	9.6	6.5	20.2	18.4	20.8
South La Jolla SMR	860	974.2	1082.6	1138.2	634.2	203.9	295.2	91.4	323.5
South Point SMR	711	447.6	502.9	470.5	662.0	227.5	349.8	132.7	17.6
Swami's SMCA	821	7.7	4.6	7.0	9.1	9.0	3.9	0.2	2.1
Swami's SMCA	822	12.5	17.4	3.2	8.7	10.0	2.5	1.3	4.7
Swami's SMCA	842	14.2	15.1	10.7	14.6	7.3	11.5	7.1	9.5
Swami's SMCA	843	10.7	4.9	5.3	19.9	6.0	2.5	5.7	4.7

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1989	1990	1991	1992	1993	1994	1995
Point Vicente SMCA	720	54.9	104.0	110.5	101.8	89.1	117.7	187.1
Richardson Rock SMR	690	541.1	675.9	1101.2	957.4	1261.7	1172.3	1123.2
Richardson Rock SMR	691	1.0	0.4	12.5	7.7	6.3	1.7	2.7
SWAT 1	829	42.3	211.4	170.5	111.9	341.0	67.7	68.7
SWAT 1	830	3.7	0.6	1.3	0.4	0.1	3.3	8.3
Wilson Cove	828	0.0	-	-	0.2	0.2	0.0	1.0
Wilson Cove	829	42.3	211.4	170.5	111.9	341.0	67.7	68.7
Wilson Cove	849	32.4	26.0	21.4	30.9	22.2	28.3	38.6
Wilson Cove	850	159.7	247.9	373.1	223.6	178.3	520.6	1961.1
San Diego-Scripps Coastal SMCA	842	5.2	11.8	12.8	2.8	2.5	2.2	8.0
Santa Barbara Island SMR	764	0.1	0.0	0.2	1.6	1.3	0.4	3.0
Santa Barbara Island SMR	765	39.6	53.0	66.9	61.8	173.2	405.1	202.1
Scorpion SMR	685	15.5	39.0	53.3	76.2	40.0	75.4	80.1
Skunk Point SMR	710	101.8	72.1	185.6	144.7	124.9	191.7	101.7
South La Jolla SMCA	860	504.5	641.0	701.8	621.9	728.8	768.8	716.2
South La Jolla SMCA	861	21.5	37.2	17.3	25.4	26.9	19.2	11.4
South La Jolla SMR	860	504.5	641.0	701.8	621.9	728.8	768.8	716.2
South Point SMR	711	53.4	149.4	494.6	610.6	655.6	937.7	502.2
Swami's SMCA	821	1.3	1.7	16.1	8.5	6.3	5.7	20.6
Swami's SMCA	822	7.0	5.8	2.2	11.8	14.2	12.4	10.3
Swami's SMCA	842	5.2	11.8	12.8	2.8	2.5	2.2	8.0
Swami's SMCA	843	1.5	2.7	0.9	3.3	3.1	0.9	1.7

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	1996	1997	1998	1999	2000	2001	2002
Point Vicente SMCA	720	149.7	121.7	82.0	130.5	152.4	166.3	215.5
Richardson Rock SMR	690	1215.3	870.4	569.1	832.1	470.8	395.0	390.4
Richardson Rock SMR	691	2.0	1.5	1.4	2.3	0.1	0.1	-
SWAT 1	829	543.9	330.4	62.5	155.8	307.9	240.6	167.3
SWAT 1	830	2.1	0.7	0.5	0.1	7.0	0.3	1.7
Wilson Cove	828	0.1	0.1	0.2	0.1	0.4	1.6	0.8
Wilson Cove	829	543.9	330.4	62.5	155.8	307.9	240.6	167.3
Wilson Cove	849	31.8	28.5	15.3	12.7	37.9	23.9	19.7
Wilson Cove	850	1548.3	1126.8	241.0	418.5	1086.4	891.0	364.9
San Diego-Scripps Coastal SMCA	842	7.8	11.1	4.6	12.4	26.3	26.5	18.5
Santa Barbara Island SMR	764	0.4	0.6	0.9	0.1	0.2	0.6	0.3
Santa Barbara Island SMR	765	88.2	74.8	66.5	89.5	128.4	54.9	54.1
Scorpion SMR	685	45.7	52.3	34.2	20.9	26.0	25.0	25.9
Skunk Point SMR	710	108.8	124.9	70.8	183.6	125.2	143.5	258.7
South La Jolla SMCA	860	769.9	523.1	291.9	291.4	417.5	483.7	566.0
South La Jolla SMCA	861	28.1	26.3	15.0	12.2	14.1	31.3	41.0
South La Jolla SMR	860	769.9	523.1	291.9	291.4	417.5	483.7	566.0
South Point SMR	711	706.9	626.2	417.3	484.5	330.9	312.0	497.8
Swami's SMCA	821	23.0	27.0	10.9	8.2	21.8	23.2	15.2
Swami's SMCA	822	16.8	11.3	10.4	0.9	3.4	4.1	14.7
Swami's SMCA	842	7.8	11.1	4.6	12.4	26.3	26.5	18.5
Swami's SMCA	843	0.4	0.8	2.0	3.0	1.3	1.7	1.2

Table H.1 (continued). Harvest (metric tons) by year of all commercially and recreationally (CPFV) caught shallow reef-associated species in each fishing block that overlaps with an MPA in the SCSR. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	2003	2004	2005	2006	2007	2008	2009	Total (1980-2009)
Point Vicente SMCA	720	161.9	164.4	88.8	58.9	73.6	156.0	107.5	3504.5
Richardson Rock SMR	690	576.9	990.2	939.3	979.3	907.4	880.4	953.3	29639.9
Richardson Rock SMR	691	-	-	-	-	0.5	-	0.1	57.1
SWAT 1	829	131.7	109.6	120.5	80.4	34.1	73.3	51.1	3630.5
SWAT 1	830	-	0.3	-	-	0.0	0.1	0.2	31.7
Wilson Cove	828	0.3	0.3	-	0.2	0.9	-	0.1	6.8
Wilson Cove	829	131.7	109.6	120.5	80.4	34.1	73.3	51.1	3630.5
Wilson Cove	849	17.3	23.4	21.2	28.7	30.8	41.7	12.3	682.3
Wilson Cove	850	111.0	354.9	224.5	269.2	176.9	121.9	103.3	11904.1
San Diego-Scripps Coastal SMCA	842	12.3	18.4	18.0	12.8	12.0	11.2	8.8	336.0
Santa Barbara Island SMR	764	-	0.8	-	2.0	0.0	0.0	2.8	21.5
Santa Barbara Island SMR	765	36.4	29.9	59.9	149.6	41.7	35.9	25.7	2364.4
Scorpion SMR	685	44.2	32.1	22.7	15.4	21.7	38.0	35.0	1095.2
Skunk Point SMR	710	218.7	122.3	100.5	109.3	129.1	87.0	124.2	6406.2
South La Jolla SMCA	860	507.5	527.1	448.1	505.6	413.1	459.5	454.9	16085.5
South La Jolla SMCA	861	42.7	26.6	21.8	13.2	15.3	8.4	14.3	594.3
South La Jolla SMR	860	507.5	527.1	448.1	505.6	413.1	459.5	454.9	16085.5
South Point SMR	711	508.1	472.5	351.1	306.5	263.9	302.8	347.7	12142.5
Swami's SMCA	821	22.4	26.9	20.6	22.9	11.9	17.7	20.4	376.0
Swami's SMCA	822	14.3	5.0	5.1	12.8	6.3	6.0	6.5	241.6
Swami's SMCA	842	12.3	18.4	18.0	12.8	12.0	11.2	8.8	336.0
Swami's SMCA	843	0.4	0.3	0.1	0.7	1.1	0.2	-	86.9

Table H.2. Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Amphistichus koelzi*	*Anarrhichthys ocellatus*	*Anisotremus davidsonii*	*Aplysia spp.*	*Cancer spp.*	*Caulolatilus princeps*	*Cebidichthys violaceus*	*Cephaloscyllium ventriosum*
Abalone Cove SMCA	720	-	0.01	0.34	41.43	190.13	14.50	-	0.01
Anacapa Island SMCA	684	-	-	0.00	-	60.92	26.38	-	-
Anacapa Island SMR	684	-	-	0.00	-	60.92	26.38	-	-
Arrow Point to Lion Head Point SMCA	761	-	-	1.99	0.52	0.06	15.63	-	0.00
Arrow Point to Lion Head Point SMCA	762	-	-	1.90	-	1.81	13.76	-	0.00
Begg Rock SMR	768	-	0.00	-	-	1.77	0.41	-	-
Begg Rock SMR	769	-	-	-	-	0.02	0.53	-	-
Begg Rock SMR	814	-	-	0.00	-	8.79	8.73	0.01	-
Begg Rock SMR	815	-	-	-	-	0.44	0.68	-	-
Bird Rock SMCA	741	-	-	0.00	-	0.02	2.39	-	-
Bird Rock SMCA	761	-	-	1.99	0.52	0.06	15.63	-	0.00
Blue Cavern SMCA	761	-	-	1.99	0.52	0.06	15.63	-	0.00
Cabrillo SMR	860	0.00	0.01	0.53	0.81	550.62	12.89	0.01	0.01
Cabrillo SMR	878	-	-	0.01	-	388.15	6.15	-	-
Campus Point SMCA	654	-	0.00	0.00	0.09	110.11	0.43	-	0.01
Carrington Point SMR	688	-	-	0.00	-	1159.07	24.17	0.00	-
Casino Point SMCA	760	-	-	0.29	-	0.17	3.64	-	-
Cat Harbor SMCA	762	-	-	1.90	-	1.81	13.76	-	0.00
Crystal Cove SMCA	737	-	-	0.05	-	16.35	0.18	-	-
Crystal Cove SMCA	738	-	0.02	0.19	0.09	36.36	3.17	-	0.00
Dana Point SMCA	737	-	-	0.05	-	16.35	0.18	-	-
Dana Point SMCA	757	-	-	0.13	-	44.83	0.34	-	-
Farnsworth Offshore SMCA	761	-	-	1.99	0.52	0.06	15.63	-	0.00
Farnsworth Offshore SMCA	762	-	-	1.90	-	1.81	13.76	-	0.00
Farnsworth Offshore SMCA	807	-	-	2.07	-	0.06	4.60	-	0.01
Farnsworth Offshore SMCA	808	-	-	0.01	-	1.67	0.54	-	-
Farnsworth Onshore SMCA	761	-	-	1.99	0.52	0.06	15.63	-	0.00
Farnsworth Onshore SMCA	807	-	-	2.07	-	0.06	4.60	-	0.01

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Cheilotrema saturnum*	*Chromis punctipinnis*	*Citharichthys sordidus*	*Crassadoma gigantea*	*Embiotoca jacksoni*	*Girella nigricans*	*Gymnothorax mordax*	*Halichoeres semicinctus*
Abalone Cove SMCA	720	0.03	0.22	0.02	0.01	0.56	2.80	0.08	0.01
Anacapa Island SMCA	684	-	0.08	-	1.33	0.01	0.80	0.00	0.00
Anacapa Island SMR	684	-	0.08	-	1.33	0.01	0.80	0.00	0.00
Arrow Point to Lion Head Point SMCA	761	-	0.10	-	0.07	0.01	3.19	0.04	0.00
Arrow Point to Lion Head Point SMCA	762	0.00	0.04	-	0.06	0.00	1.54	5.94	0.00
Begg Rock SMR	768	-	-	-	0.01	-	-	-	-
Begg Rock SMR	769	-	-	-	0.12	-	-	-	-
Begg Rock SMR	814	-	0.00	-	0.14	-	-	-	-
Begg Rock SMR	815	-	-	-	0.00	-	-	-	-
Bird Rock SMCA	741	-	0.01	-	0.00	3.63	0.04	-	-
Bird Rock SMCA	761	-	0.10	-	0.07	0.01	3.19	0.04	0.00
Blue Cavern SMCA	761	-	0.10	-	0.07	0.01	3.19	0.04	0.00
Cabrillo SMR	860	2.14	0.00	0.04	0.04	1.21	2.21	9.07	0.00
Cabrillo SMR	878	0.00	0.00	0.00	0.00	0.02	0.03	0.08	0.00
Campus Point SMCA	654	-	0.01	-	0.02	0.00	0.00	0.03	0.00
Carrington Point SMR	688	-	0.01	-	0.20	-	-	0.07	-
Casino Point SMCA	760	-	0.03	0.02	0.01	0.00	0.19	-	0.00
Cat Harbor SMCA	762	0.00	0.04	-	0.06	0.00	1.54	5.94	0.00
Crystal Cove SMCA	737	0.01	0.05	-	-	0.00	0.02	0.82	0.00
Crystal Cove SMCA	738	0.21	0.39	0.02	0.00	0.10	0.33	0.16	0.03
Dana Point SMCA	737	0.01	0.05	-	-	0.00	0.02	0.82	0.00
Dana Point SMCA	757	0.03	0.03	-	0.00	0.00	0.24	1.76	0.00
Farnsworth Offshore SMCA	761	-	0.10	-	0.07	0.01	3.19	0.04	0.00
Farnsworth Offshore SMCA	762	0.00	0.04	-	0.06	0.00	1.54	5.94	0.00
Farnsworth Offshore SMCA	807	0.00	0.11	-	0.00	0.24	0.73	0.05	0.00
Farnsworth Offshore SMCA	808	-	-	-	-	-	0.03	-	-
Farnsworth Onshore SMCA	761	-	0.10	-	0.07	0.01	3.19	0.04	0.00
Farnsworth Onshore SMCA	807	0.00	0.11	-	0.00	0.24	0.73	0.05	0.00

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Haliotis assimilis*	*Haliotis corrugata*	*Haliotis cracherodii*	*Haliotis fulgens*	*Haliotis kamtschatkana*	*Haliotis rufescens*	*Haliotis sorenseni*	*Haliotis walallensis*
Abalone Cove SMCA	720	-	0.02	-	-	-	0.96	-	-
Anacapa Island SMCA	684	-	3.91	1.91	0.07	-	1.36	0.07	-
Anacapa Island SMR	684	-	3.91	1.91	0.07	-	1.36	0.07	-
Arrow Point to Lion Head Point SMCA	761	-	0.58	0.35	1.88	-	0.04	-	-
Arrow Point to Lion Head Point SMCA	762	-	5.21	1.97	10.72	-	0.03	0.05	-
Begg Rock SMR	768	-	0.16	0.59	-	-	0.45	-	-
Begg Rock SMR	769	-	0.28	1.54	-	-	0.62	-	-
Begg Rock SMR	814	-	7.17	76.83	4.55	-	33.09	-	-
Begg Rock SMR	815	-	0.05	3.31	0.03	-	0.13	-	-
Bird Rock SMCA	741	-	-	-	-	-	1.32	-	-
Bird Rock SMCA	761	-	0.58	0.35	1.88	-	0.04	-	-
Blue Cavern SMCA	761	-	0.58	0.35	1.88	-	0.04	-	-
Cabrillo SMR	860	0.00	19.31	6.20	7.51	0.00	80.85	0.40	-
Cabrillo SMR	878	-	0.03	0.23	0.00	-	0.40	-	-
Campus Point SMCA	654	0.01	0.25	0.06	0.01	-	11.57	0.04	0.01
Carrington Point SMR	688	-	1.63	6.65	0.06	-	12.41	-	-
Casino Point SMCA	760	-	0.37	-	0.35	-	0.51	-	-
Cat Harbor SMCA	762	-	5.21	1.97	10.72	-	0.03	0.05	-
Crystal Cove SMCA	737	-	-	-	-	-	-	-	-
Crystal Cove SMCA	738	-	-	-	-	-	-	-	-
Dana Point SMCA	737	-	-	-	-	-	-	-	-
Dana Point SMCA	757	-	0.19	-	0.06	-	0.21	-	-
Farnsworth Offshore SMCA	761	-	0.58	0.35	1.88	-	0.04	-	-
Farnsworth Offshore SMCA	762	-	5.21	1.97	10.72	-	0.03	0.05	-
Farnsworth Offshore SMCA	807	-	2.37	0.47	13.29	-	0.09	0.03	-
Farnsworth Offshore SMCA	808	-	-	-	-	-	-	-	-
Farnsworth Onshore SMCA	761	-	0.58	0.35	1.88	-	0.04	-	-
Farnsworth Onshore SMCA	807	-	2.37	0.47	13.29	-	0.09	0.03	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Hermosilla azurea*	*Heterodontus francisci*	*Heterostichus rostratus*	*Hexagrammos decagrammus*	*Hypsurus caryi*	*Hypsypops rubicundus*	*Kelletia Kelleti*	*Lythrypnus dalli*
Abalone Cove SMCA	720	-	0.01	0.00	-	0.00	0.01	22.67	-
Anacapa Island SMCA	684	-	0.00	-	0.00	-	-	0.20	0.00
Anacapa Island SMR	684	-	0.00	-	0.00	-	-	0.20	0.00
Arrow Point to Lion Head Point SMCA	761	-	0.07	0.00	-	0.00	0.21	0.52	0.01
Arrow Point to Lion Head Point SMCA	762	-	0.01	0.00	0.00	0.00	0.00	0.17	-
Begg Rock SMR	768	-	-	-	-	-	-	-	-
Begg Rock SMR	769	-	-	-	-	-	-	-	-
Begg Rock SMR	814	-	-	-	0.00	0.00	-	-	-
Begg Rock SMR	815	-	-	-	0.00	-	-	-	-
Bird Rock SMCA	741	-	-	-	-	-	-	-	-
Bird Rock SMCA	761	-	0.07	0.00	-	0.00	0.21	0.52	0.01
Blue Cavern SMCA	761	-	0.07	0.00	-	0.00	0.21	0.52	0.01
Cabrillo SMR	860	0.29	6.88	0.00	0.00	-	0.00	74.60	-
Cabrillo SMR	878	-	-	-	-	-	-	27.33	-
Campus Point SMCA	654	-	-	0.00	0.01	0.00	-	30.19	-
Carrington Point SMR	688	-	-	-	0.01	0.01	-	24.50	-
Casino Point SMCA	760	-	0.00	0.00	-	-	-	0.04	-
Cat Harbor SMCA	762	-	0.01	0.00	0.00	0.00	0.00	0.17	-
Crystal Cove SMCA	737	-	-	-	-	-	-	6.96	-
Crystal Cove SMCA	738	0.05	-	0.00	0.02	0.00	0.00	8.39	0.00
Dana Point SMCA	737	-	-	-	-	-	-	6.96	-
Dana Point SMCA	757	-	0.00	0.00	0.01	0.00	-	34.29	-
Farnsworth Offshore SMCA	761	-	0.07	0.00	-	0.00	0.21	0.52	0.01
Farnsworth Offshore SMCA	762	-	0.01	0.00	0.00	0.00	0.00	0.17	-
Farnsworth Offshore SMCA	807	-	0.01	0.00	-	0.00	-	0.58	-
Farnsworth Offshore SMCA	808	-	-	-	-	-	-	-	-
Farnsworth Onshore SMCA	761	-	0.07	0.00	-	0.00	0.21	0.52	0.01
Farnsworth Onshore SMCA	807	-	0.01	0.00	-	0.00	-	0.58	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Medialuna californiensis*	*Megathura crenulata*	*Mycteroperca xenarcha*	*Myliobatis californica*	*Ophiodon elongatus*	*Oxyjulis californica*	*Panulirus interruptus*	*Paralabrax clathratus*
Abalone Cove SMCA	720	10.06	0.11	-	0.05	7.60	0.01	237.66	389.18
Anacapa Island SMCA	684	23.42	-	-	0.02	19.26	-	131.11	231.34
Anacapa Island SMR	684	23.42	-	-	0.02	19.26	-	131.11	231.34
Arrow Point to Lion Head Point SMCA	761	53.67	-	-	0.11	2.76	0.01	32.67	565.01
Arrow Point to Lion Head Point SMCA	762	32.42	-	-	0.12	6.33	0.00	107.06	289.36
Begg Rock SMR	768	0.07	-	-	-	7.86	-	1.63	1.06
Begg Rock SMR	769	0.04	-	-	-	3.47	-	0.78	0.74
Begg Rock SMR	814	0.20	-	-	-	15.36	-	138.25	8.27
Begg Rock SMR	815	0.02	-	-	-	0.84	-	0.48	0.01
Bird Rock SMCA	741	0.91	-	-	0.03	0.68	-	1.56	10.51
Bird Rock SMCA	761	53.67	-	-	0.11	2.76	0.01	32.67	565.01
Blue Cavern SMCA	761	53.67	-	-	0.11	2.76	0.01	32.67	565.01
Cabrillo SMR	860	1.67	0.01	0.07	1.25	42.56	0.00	1504.20	738.31
Cabrillo SMR	878	0.10	0.05	-	0.11	7.43	-	28.33	161.22
Campus Point SMCA	654	0.17	-	-	-	1.85	0.00	111.96	89.26
Carrington Point SMR	688	0.07	-	-	0.03	28.24	0.00	209.86	5.03
Casino Point SMCA	760	10.68	-	-	0.05	1.22	0.00	2.30	155.65
Cat Harbor SMCA	762	32.42	-	-	0.12	6.33	0.00	107.06	289.36
Crystal Cove SMCA	737	0.45	-	-	0.03	0.19	0.00	108.05	32.97
Crystal Cove SMCA	738	2.50	-	-	0.62	5.39	0.00	112.43	188.53
Dana Point SMCA	737	0.45	-	-	0.03	0.19	0.00	108.05	32.97
Dana Point SMCA	757	0.60	-	-	0.33	0.52	0.00	346.09	147.34
Farnsworth Offshore SMCA	761	53.67	-	-	0.11	2.76	0.01	32.67	565.01
Farnsworth Offshore SMCA	762	32.42	-	-	0.12	6.33	0.00	107.06	289.36
Farnsworth Offshore SMCA	807	15.38	-	-	0.68	1.91	-	71.79	175.37
Farnsworth Offshore SMCA	808	0.47	-	-	-	0.02	-	0.20	2.37
Farnsworth Onshore SMCA	761	53.67	-	-	0.11	2.76	0.01	32.67	565.01
Farnsworth Onshore SMCA	807	15.38	-	-	0.68	1.91	-	71.79	175.37

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Paralabrax nebulifer*	*Parastichopus parvimensis*	*Phanerodon furcatus*	*Pleuronichthys coenosus*	*Rhacochilus toxotes*	*Rhacochilus vacca*	*Scorpaena guttata*	*Scorpaenichthys marmoratus*	*Sebastes atrovirens*
Abalone Cove SMCA	720	299.21	30.66	0.00	0.00	0.16	0.01	106.31	3.85	0.01
Anacapa Island SMCA	684	33.50	2.50	0.00	0.00	0.03	-	42.12	1.59	-
Anacapa Island SMR	684	33.50	2.50	0.00	0.00	0.03	-	42.12	1.59	-
Arrow Point to Lion Head Point SMCA	761	31.10	50.73	0.00	0.01	0.03	0.00	26.12	0.75	0.00
Arrow Point to Lion Head Point SMCA	762	12.31	55.66	-	-	0.03	0.00	30.37	0.45	-
Begg Rock SMR	768	1.17	1.04	-	-	0.01	-	0.10	0.01	-
Begg Rock SMR	769	0.74	1.30	-	-	-	-	0.32	0.02	-
Begg Rock SMR	814	0.18	32.01	-	-	0.02	-	5.96	10.72	0.03
Begg Rock SMR	815	0.12	0.28	-	-	-	-	0.01	0.01	0.00
Bird Rock SMCA	741	22.07	-	-	-	-	-	6.82	0.11	-
Bird Rock SMCA	761	31.10	50.73	0.00	0.01	0.03	0.00	26.12	0.75	0.00
Blue Cavern SMCA	761	31.10	50.73	0.00	0.01	0.03	0.00	26.12	0.75	0.00
Cabrillo SMR	860	181.18	15.57	0.00	-	0.05	0.00	102.48	7.03	0.03
Cabrillo SMR	878	527.60	0.37	-	-	0.03	-	101.44	2.49	0.01
Campus Point SMCA	654	6.36	1.55	-	-	0.01	-	0.75	5.85	0.02
Carrington Point SMR	688	0.12	7.30	0.00	-	0.00	-	0.67	5.35	0.19
Casino Point SMCA	760	29.75	1.92	0.00	-	0.00	-	12.78	0.27	-
Cat Harbor SMCA	762	12.31	55.66	-	-	0.03	0.00	30.37	0.45	-
Crystal Cove SMCA	737	50.83	1.82	-	-	0.00	-	9.70	0.74	-
Crystal Cove SMCA	738	859.42	0.73	0.01	-	0.10	-	125.61	3.80	0.00
Dana Point SMCA	737	50.83	1.82	-	-	0.00	-	9.70	0.74	-
Dana Point SMCA	757	150.87	0.04	-	-	0.03	0.00	14.72	1.64	-
Farnsworth Offshore SMCA	761	31.10	50.73	0.00	0.01	0.03	0.00	26.12	0.75	0.00
Farnsworth Offshore SMCA	762	12.31	55.66	-	-	0.03	0.00	30.37	0.45	-
Farnsworth Offshore SMCA	807	5.06	3.92	-	0.00	0.00	-	13.72	0.18	0.00
Farnsworth Offshore SMCA	808	0.21	-	-	-	-	-	1.58	0.01	-
Farnsworth Onshore SMCA	761	31.10	50.73	0.00	0.01	0.03	0.00	26.12	0.75	0.00
Farnsworth Onshore SMCA	807	5.06	3.92	-	0.00	0.00	-	13.72	0.18	0.00

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Sebastes auriculatus*	*Sebastes carnatus*	*Sebastes caurinus*	*Sebastes chrysomelas*	*Sebastes dallii*	*Sebastes hopkinsi*	*Sebastes mystinus*	*Sebastes rastrelliger*	*Sebastes serranoides*
Abalone Cove SMCA	720	0.25	0.03	1.26	-	-	-	0.24	0.02	1.03
Anacapa Island SMCA	684	0.02	0.87	7.58	-	-	-	3.81	0.16	-
Anacapa Island SMR	684	0.02	0.87	7.58	-	-	-	3.81	0.16	-
Arrow Point to Lion Head Point SMCA	761	-	0.10	0.18	-	-	-	0.04	0.08	0.00
Arrow Point to Lion Head Point SMCA	762	-	0.13	0.96	-	-	-	0.12	0.00	0.44
Begg Rock SMR	768	-	1.62	0.02	-	-	-	0.00	0.00	-
Begg Rock SMR	769	-	1.00	0.43	-	-	-	-	-	-
Begg Rock SMR	814	-	0.96	0.73	0.00	-	-	0.16	1.01	0.00
Begg Rock SMR	815	-	0.02	0.39	-	-	-	0.02	0.05	-
Bird Rock SMCA	741	-	0.01	0.25	-	-	-	-	0.02	-
Bird Rock SMCA	761	-	0.10	0.18	-	-	-	0.04	0.08	0.00
Blue Cavern SMCA	761	-	0.10	0.18	-	-	-	0.04	0.08	0.00
Cabrillo SMR	860	0.33	1.25	0.69	0.01	0.00	0.02	0.55	0.29	0.22
Cabrillo SMR	878	0.11	0.74	0.70	0.00	-	0.00	0.01	-	0.00
Campus Point SMCA	654	0.06	0.34	0.17	0.01	-	-	0.05	5.81	0.01
Carrington Point SMR	688	0.24	2.09	20.42	0.09	-	0.00	3.01	5.33	0.30
Casino Point SMCA	760	-	0.01	0.04	-	-	0.04	0.01	-	-
Cat Harbor SMCA	762	-	0.13	0.96	-	-	-	0.12	0.00	0.44
Crystal Cove SMCA	737	-	0.00	0.00	-	-	-	0.00	0.00	0.02
Crystal Cove SMCA	738	0.01	0.04	0.02	0.01	-	0.17	0.03	0.00	0.12
Dana Point SMCA	737	-	0.00	0.00	-	-	-	0.00	0.00	0.02
Dana Point SMCA	757	0.00	0.02	0.02	0.00	-	-	0.02	-	0.02
Farnsworth Offshore SMCA	761	-	0.10	0.18	-	-	-	0.04	0.08	0.00
Farnsworth Offshore SMCA	762	-	0.13	0.96	-	-	-	0.12	0.00	0.44
Farnsworth Offshore SMCA	807	0.00	0.01	0.13	0.00	-	-	0.03	0.02	0.00
Farnsworth Offshore SMCA	808	0.03	-	0.04	-	-	-	-	0.01	0.01
Farnsworth Onshore SMCA	761	-	0.10	0.18	-	-	-	0.04	0.08	0.00
Farnsworth Onshore SMCA	807	0.00	0.01	0.13	0.00	-	-	0.03	0.02	0.00

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Sebastes serriceps*	*Sebastes umbrosus*	*Semicossyphus pulcher*	*Squatina californica*	*Stereolepis gigas*	*Strongylocentrotus franciscanus*	*Strongylocentrotus purpuratus*	*Torpedo californica*	*Triakis semifasciata*	*Xenistius californiensis*
Abalone Cove SMCA	720	0.00	-	30.65	0.33	2.78	2054.85	46.17	0.53	7.63	-
Anacapa Island SMCA	684	0.03	-	55.47	8.80	16.89	466.30	0.25	-	1.07	-
Anacapa Island SMR	684	0.03	-	55.47	8.80	16.89	466.30	0.25	-	1.07	-
Arrow Point to Lion Head Point SMCA	761	0.04	-	87.89	5.50	0.87	148.67	-	0.36	0.48	0.00
Arrow Point to Lion Head Point SMCA	762	0.01	-	84.94	22.71	2.48	691.72	2.21	0.01	2.87	-
Begg Rock SMR	768	-	-	1.43	0.15	-	18.46	-	-	-	-
Begg Rock SMR	769	0.00	-	7.86	-	-	18.68	-	-	0.20	-
Begg Rock SMR	814	0.15	-	76.76	-	0.35	6405.04	36.71	-	0.45	-
Begg Rock SMR	815	-	-	1.84	-	0.06	530.70	-	-	-	-
Bird Rock SMCA	741	-	-	7.70	0.01	0.39	39.53	0.32	0.02	1.50	-
Bird Rock SMCA	761	0.04	-	87.89	5.50	0.87	148.67	-	0.36	0.48	0.00
Blue Cavern SMCA	761	0.04	-	87.89	5.50	0.87	148.67	-	0.36	0.48	0.00
Cabrillo SMR	860	0.37	0.00	185.46	6.49	3.74	12490.3	12.34	0.00	13.32	0.00
Cabrillo SMR	878	0.01	0.00	9.21	2.00	0.73	3.90	-	0.01	2.24	-
Campus Point SMCA	654	0.00	-	2.42	30.65	0.13	760.38	1.86	0.08	0.96	-
Carrington Point SMR	688	0.18	-	35.07	55.18	1.31	7135.76	6.67	-	4.07	-
Casino Point SMCA	760	-	-	20.67	2.05	0.24	73.39	-	-	0.33	-
Cat Harbor SMCA	762	0.01	-	84.94	22.71	2.48	691.72	2.21	0.01	2.87	-
Crystal Cove SMCA	737	0.01	-	24.25	-	0.72	36.38	0.65	-	0.24	-
Crystal Cove SMCA	738	0.03	0.00	35.54	1.66	3.08	32.20	1.74	0.01	0.77	-
Dana Point SMCA	737	0.01	-	24.25	-	0.72	36.38	0.65	-	0.24	-
Dana Point SMCA	757	0.01	-	33.43	0.13	0.70	1227.13	0.64	-	2.01	0.00
Farnsworth Offshore SMCA	761	0.04	-	87.89	5.50	0.87	148.67	-	0.36	0.48	0.00
Farnsworth Offshore SMCA	762	0.01	-	84.94	22.71	2.48	691.72	2.21	0.01	2.87	-
Farnsworth Offshore SMCA	807	0.00	-	29.37	1.99	1.22	167.30	-	0.04	0.42	-
Farnsworth Offshore SMCA	808	-	-	0.69	-	-	3.71	-	-	0.06	-
Farnsworth Onshore SMCA	761	0.04	-	87.89	5.50	0.87	148.67	-	0.36	0.48	0.00
Farnsworth Onshore SMCA	807	0.00	-	29.37	1.99	1.22	167.30	-	0.04	0.42	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Amphistichus koelzi*	*Anarrhichthys ocellatus*	*Anisotremus davidsonii*	*Aplysia spp.*	*Cancer spp.*	*Caulolatilus princeps*	*Cebidichthys violaceus*	*Cephaloscyllium ventriosum*
Footprint SMR	707	-	-	0.00	-	8.53	3.04	-	-
Footprint SMR	708	-	-	0.01	-	32.87	7.55	-	0.01
Gull Island SMR	709	0.00	0.01	0.04	-	119.37	7.48	-	-
Gull Island SMR	710	-	-	0.00	-	197.50	8.77	-	-
Harris Point SMR	689	-	-	-	-	142.16	9.69	-	-
Harris Point SMR	690	-	-	0.10	-	137.77	15.91	0.01	-
Judith Rock SMR	690	-	-	0.10	-	137.77	15.91	0.01	-
Judith Rock SMR	713	-	-	0.01	-	450.84	1.45	-	-
Kashtayit SMCA	656	-	0.00	-	-	469.21	0.28	-	0.10
Laguna Beach SMCA	737	-	-	0.05	-	16.35	0.18	-	-
Laguna Beach SMR	737	-	-	0.05	-	16.35	0.18	-	-
Long Point SMR	761	-	-	1.99	0.52	0.06	15.63	-	0.00
Lover's Cove SMCA	760	-	-	0.29	-	0.17	3.64	-	-
Matlahuayl SMR	842	-	0.00	0.04	-	48.12	3.14	-	-
Naples SMCA	654	-	0.00	0.00	0.09	110.11	0.43	-	0.01
Painted Cave SMCA	687	-	-	0.04	-	188.70	10.41	-	0.18
Point Conception SMR	657	-	-	0.01	-	852.84	0.68	-	0.00
Point Conception SMR	658	-	-	-	-	104.40	0.45	-	-
Point Dume SMCA	680	-	-	0.00	0.38	152.09	1.55	-	0.00
Point Dume SMCA	681	-	-	0.01	-	45.95	3.16	-	0.01
Point Dume SMCA	703	-	-	-	0.20	7.43	0.14	-	-
Point Dume SMCA	704	-	-	-	-	10.08	0.07	-	-
Point Dume SMR	680	-	-	0.00	0.38	152.09	1.55	-	0.00
Point Dume SMR	703	-	-	-	0.20	7.43	0.14	-	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Cheilotrema saturnum*	*Chromis punctipinnis*	*Citharichthys sordidus*	*Crassadoma gigantea*	*Embiotoca jacksoni*	*Girella nigricans*	*Gymnothorax mordax*	*Halichoeres semicinctus*
Footprint SMR	707	-	0.11	0.05	0.03	-	0.07	-	0.00
Footprint SMR	708	-	0.01	0.00	0.56	0.01	0.05	0.08	-
Gull Island SMR	709	-	0.00	-	0.51	0.00	0.29	-	-
Gull Island SMR	710	-	0.01	-	0.39	0.00	0.04	-	-
Harris Point SMR	689	-	0.00	-	0.57	-	0.00	0.87	-
Harris Point SMR	690	-	0.00	-	1.13	0.00	0.36	0.02	-
Judith Rock SMR	690	-	0.00	-	1.13	0.00	0.36	0.02	-
Judith Rock SMR	713	-	-	-	0.01	0.08	0.03	-	-
Kashtayit SMCA	656	-	0.00	-	0.00	-	0.02	-	-
Laguna Beach SMCA	737	0.01	0.05	-	-	0.00	0.02	0.82	0.00
Laguna Beach SMR	737	0.01	0.05	-	-	0.00	0.02	0.82	0.00
Long Point SMR	761	-	0.10	-	0.07	0.01	3.19	0.04	0.00
Lover's Cove SMCA	760	-	0.03	0.02	0.01	0.00	0.19	-	0.00
Matlahuayl SMR	842	0.00	0.00	-	0.00	-	0.00	0.43	0.00
Naples SMCA	654	-	0.01	-	0.02	0.00	0.00	0.03	0.00
Painted Cave SMCA	687	-	0.00	-	0.63	-	0.02	-	-
Point Conception SMR	657	-	0.00	-	0.00	0.00	0.00	0.04	-
Point Conception SMR	658	-	-	0.00	0.00	0.00	-	-	-
Point Dume SMCA	680	0.01	0.02	-	0.02	0.74	0.14	0.13	0.00
Point Dume SMCA	681	-	0.00	0.01	0.00	0.01	0.02	0.02	0.01
Point Dume SMCA	703	-	0.04	-	0.00	0.09	0.02	-	-
Point Dume SMCA	704	-	-	-	0.00	-	0.13	-	-
Point Dume SMR	680	0.01	0.02	-	0.02	0.74	0.14	0.13	0.00
Point Dume SMR	703	-	0.04	-	0.00	0.09	0.02	-	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Haliotis assimilis*	*Haliotis corrugata*	*Haliotis cracherodii*	*Haliotis fulgens*	*Haliotis kamtschatkana*	*Haliotis rufescens*	*Haliotis sorenseni*	*Haliotis walallensis*
Footprint SMR	707	-	1.26	0.00	0.00	-	1.43	0.01	-
Footprint SMR	708	-	8.02	1.70	0.21	-	11.65	0.00	-
Gull Island SMR	709	0.00	17.67	2.38	0.57	-	25.35	0.01	-
Gull Island SMR	710	0.00	4.69	3.90	0.08	-	12.15	0.00	-
Harris Point SMR	689	0.01	3.57	113.63	0.24	-	41.59	-	-
Harris Point SMR	690	0.00	15.37	592.66	2.58	0.02	798.10	0.01	0.00
Judith Rock SMR	690	0.00	15.37	592.66	2.58	0.02	798.10	0.01	0.00
Judith Rock SMR	713	-	0.36	1.35	0.04	-	0.64	-	-
Kashtayit SMCA	656	-	0.06	0.00	-	-	10.22	0.00	-
Laguna Beach SMCA	737	-	-	-	-	-	-	-	-
Laguna Beach SMR	737	-	-	-	-	-	-	-	-
Long Point SMR	761	-	0.58	0.35	1.88	-	0.04	-	-
Lover's Cove SMCA	760	-	0.37	-	0.35	-	0.51	-	-
Matlahuayl SMR	842	-	0.14	-	0.15	0.00	0.48	0.03	-
Naples SMCA	654	0.01	0.25	0.06	0.01	-	11.57	0.04	0.01
Painted Cave SMCA	687	-	2.73	2.45	0.08	-	5.27	-	-
Point Conception SMR	657	0.02	1.97	3.53	0.05	-	108.81	0.00	-
Point Conception SMR	658	-	0.00	-	-	-	3.36	0.06	-
Point Dume SMCA	680	-	0.55	1.61	0.21	-	1.46	-	-
Point Dume SMCA	681	-	0.01	0.01	-	-	0.13	-	-
Point Dume SMCA	703	-	-	-	-	-	-	-	-
Point Dume SMCA	704	-	-	-	-	-	-	-	-
Point Dume SMR	680	-	0.55	1.61	0.21	-	1.46	-	-
Point Dume SMR	703	-	-	-	-	-	-	-	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Hermosilla azurea*	*Heterodontus francisci*	*Heterostichus rostratus*	*Hexagrammos decagrammus*	*Hypsurus caryi*	*Hypsypops rubicundus*	*Kelletia Kelleti*	*Lythrypnus dalli*
Footprint SMR	707	-	0.05	0.00	0.03	0.00	-	0.14	-
Footprint SMR	708	-	-	-	0.00	0.00	-	3.26	-
Gull Island SMR	709	-	-	-	-	-	-	0.12	-
Gull Island SMR	710	-	-	-	0.00	-	-	5.11	-
Harris Point SMR	689	-	-	-	0.00	-	-	1.68	-
Harris Point SMR	690	-	-	-	0.09	0.01	-	0.90	-
Judith Rock SMR	690	-	-	-	0.09	0.01	-	0.90	-
Judith Rock SMR	713	-	-	-	-	0.01	-	7.86	-
Kashtayit SMCA	656	-	-	-	0.04	-	-	5.57	-
Laguna Beach SMCA	737	-	-	-	-	-	-	6.96	-
Laguna Beach SMR	737	-	-	-	-	-	-	6.96	-
Long Point SMR	761	-	0.07	0.00	-	0.00	0.21	0.52	0.01
Lover's Cove SMCA	760	-	0.00	0.00	-	-	-	0.04	-
Matlahuayl SMR	842	-	-	-	-	-	-	1.77	-
Naples SMCA	654	-	-	0.00	0.01	0.00	-	30.19	-
Painted Cave SMCA	687	-	-	-	0.00	0.00	-	2.13	-
Point Conception SMR	657	-	-	-	0.10	-	-	11.52	-
Point Conception SMR	658	-	-	-	0.01	-	-	7.77	-
Point Dume SMCA	680	-	-	0.02	0.00	-	-	6.28	-
Point Dume SMCA	681	-	-	-	-	-	-	2.00	-
Point Dume SMCA	703	-	0.01	-	-	-	-	-	-
Point Dume SMCA	704	-	-	-	-	-	-	0.00	-
Point Dume SMR	680	-	-	0.02	0.00	-	-	6.28	-
Point Dume SMR	703	-	0.01	-	-	-	-	-	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Medialuna californiensis*	*Megathura crenulata*	*Mycteroperca xenarcha*	*Myliobatis californica*	*Ophiodon elongatus*	*Oxyjulis californica*	*Panulirus interruptus*	*Paralabrax clathratus*
Footprint SMR	707	0.73	0.14	-	-	8.56	-	40.89	15.24
Footprint SMR	708	1.27	-	-	1.13	21.05	-	256.97	83.40
Gull Island SMR	709	1.81	-	-	-	5.64	-	71.53	23.92
Gull Island SMR	710	0.75	-	-	-	13.36	-	58.76	11.36
Harris Point SMR	689	0.12	-	-	0.01	21.56	-	94.39	2.85
Harris Point SMR	690	0.18	0.01	-	-	135.95	-	31.58	3.70
Judith Rock SMR	690	0.18	0.01	-	-	135.95	-	31.58	3.70
Judith Rock SMR	713	0.18	-	-	-	4.55	-	3.11	0.21
Kashtayit SMCA	656	0.02	-	-	0.05	3.91	-	52.71	4.28
Laguna Beach SMCA	737	0.45	-	-	0.03	0.19	0.00	108.05	32.97
Laguna Beach SMR	737	0.45	-	-	0.03	0.19	0.00	108.05	32.97
Long Point SMR	761	53.67	-	-	0.11	2.76	0.01	32.67	565.01
Lover's Cove SMCA	760	10.68	-	-	0.05	1.22	0.00	2.30	155.65
Matlahuayl SMR	842	0.06	-	-	-	2.73	-	134.43	45.76
Naples SMCA	654	0.17	-	-	-	1.85	0.00	111.96	89.26
Painted Cave SMCA	687	0.25	-	-	2.37	11.00	-	54.41	21.85
Point Conception SMR	657	0.00	0.18	-	-	6.05	-	104.40	7.86
Point Conception SMR	658	-	-	-	-	2.12	-	8.51	0.57
Point Dume SMCA	680	0.33	0.00	-	0.03	3.01	-	110.15	135.31
Point Dume SMCA	681	0.35	0.04	-	-	5.71	-	36.06	179.00
Point Dume SMCA	703	0.01	-	-	0.23	2.02	-	2.83	2.99
Point Dume SMCA	704	0.05	-	-	0.01	1.59	-	17.42	2.82
Point Dume SMR	680	0.33	0.00	-	0.03	3.01	-	110.15	135.31
Point Dume SMR	703	0.01	-	-	0.23	2.02	-	2.83	2.99

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Paralabrax nebulifer*	*Parastichopus parvimensis*	*Phanerodon furcatus*	*Pleuronichthys coenosus*	*Rhacochilus toxotes*	*Rhacochilus vacca*	*Scorpaena guttata*	*Scorpaenichthys marmoratus*
Footprint SMR	707	2.63	81.82	-	-	0.00	-	7.83	0.77
Footprint SMR	708	2.43	331.22	-	-	0.10	0.03	6.59	1.49
Gull Island SMR	709	0.63	36.35	0.00	-	0.02	-	1.24	0.78
Gull Island SMR	710	2.92	7.90	-	-	0.01	-	0.81	2.37
Harris Point SMR	689	0.71	6.96	-	-	0.00	-	0.61	6.55
Harris Point SMR	690	0.28	16.39	0.00	-	0.11	-	2.29	40.58
Judith Rock SMR	690	0.28	16.39	0.00	-	0.11	-	2.29	40.58
Judith Rock SMR	713	0.20	0.39	-	-	-	-	2.67	0.45
Kashtayit SMCA	656	0.40	-	-	-	0.00	-	0.20	6.07
Laguna Beach SMCA	737	50.83	1.82	-	-	0.00	-	9.70	0.74
Laguna Beach SMR	737	50.83	1.82	-	-	0.00	-	9.70	0.74
Long Point SMR	761	31.10	50.73	0.00	0.01	0.03	0.00	26.12	0.75
Lover's Cove SMCA	760	29.75	1.92	0.00	-	0.00	-	12.78	0.27
Matlahuayl SMR	842	30.77	-	0.00	-	0.00	-	7.29	0.58
Naples SMCA	654	6.36	1.55	-	-	0.01	-	0.75	5.85
Painted Cave SMCA	687	0.83	17.25	0.00	-	0.02	-	1.05	2.14
Point Conception SMR	657	0.27	0.15	-	-	0.00	-	0.14	2.80
Point Conception SMR	658	0.46	0.18	-	-	-	-	0.07	0.99
Point Dume SMCA	680	64.83	1.57	0.04	-	0.01	-	46.34	2.38
Point Dume SMCA	681	32.62	12.04	-	-	0.00	-	6.35	2.91
Point Dume SMCA	703	7.50	-	0.08	-	-	-	5.44	0.33
Point Dume SMCA	704	1.26	-	-	-	-	-	2.51	0.05
Point Dume SMR	680	64.83	1.57	0.04	-	0.01	-	46.34	2.38
Point Dume SMR	703	7.50	-	0.08	-	-	-	5.44	0.33

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Sebastes atrovirens*	*Sebastes auriculatus*	*Sebastes carnatus*	*Sebastes caurinus*	*Sebastes chrysomelas*	*Sebastes dallii*	*Sebastes hopkinsi*	*Sebastes mystinus*	*Sebastes rastrelliger*
Footprint SMR	707	0.00	0.01	0.27	1.82	0.00	-	0.00	2.49	0.21
Footprint SMR	708	0.03	0.02	0.52	2.16	0.00	-	-	1.85	3.26
Gull Island SMR	709	0.03	0.02	0.45	2.70	0.00	-	-	0.42	1.08
Gull Island SMR	710	0.08	0.22	2.88	5.63	0.01	-	-	0.97	1.77
Harris Point SMR	689	0.04	0.02	0.92	5.99	0.03	-	-	0.98	5.88
Harris Point SMR	690	0.24	0.29	5.20	6.70	0.11	-	-	2.36	24.05
Judith Rock SMR	690	0.24	0.29	5.20	6.70	0.11	-	-	2.36	24.05
Judith Rock SMR	713	0.01	0.01	2.15	1.28	-	-	-	1.35	0.05
Kashtayit SMCA	656	0.02	0.15	0.49	0.61	0.04	-	-	0.17	6.18
Laguna Beach SMCA	737	-	-	0.00	0.00	-	-	-	0.00	0.00
Laguna Beach SMR	737	-	-	0.00	0.00	-	-	-	0.00	0.00
Long Point SMR	761	0.00	-	0.10	0.18	-	-	-	0.04	0.08
Lover's Cove SMCA	760	-	-	0.01	0.04	-	-	0.04	0.01	-
Matlahuayl SMR	842	0.00	0.04	0.03	0.02	-	0.00	0.00	0.04	0.03
Naples SMCA	654	0.02	0.06	0.34	0.17	0.01	-	-	0.05	5.81
Painted Cave SMCA	687	0.00	0.01	0.86	9.19	0.01	-	-	1.71	1.08
Point Conception SMR	657	0.00	0.57	0.81	2.35	0.32	-	-	0.22	2.15
Point Conception SMR	658	-	0.15	0.14	1.35	0.02	-	-	0.00	0.43
Point Dume SMCA	680	0.02	-	0.23	0.15	-	-	-	0.01	0.77
Point Dume SMCA	681	0.01	0.01	0.09	0.26	0.00	-	-	0.02	0.36
Point Dume SMCA	703	-	0.05	0.02	0.05	-	-	-	0.00	-
Point Dume SMCA	704	-	-	0.01	0.01	-	-	-	0.00	-
Point Dume SMR	680	0.02	-	0.23	0.15	-	-	-	0.01	0.77
Point Dume SMR	703	-	0.05	0.02	0.05	-	-	-	0.00	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Sebastes serranoides*	*Sebastes serriceps*	*Sebastes umbrosus*	*Semicossyphus pulcher*	*Squatina californica*	*Stereolepis gigas*	*Strongylocentrotus franciscanu*	*Strongylocentrotus purpuratus*	*Torpedo californica*	*Triakis semifasciata*	*Xenistius californiensis*
Footprint SMR	707	-	0.01	-	11.11	0.78	0.67	460.22	1.03	-	0.22	-
Footprint SMR	708	0.02	0.07	-	37.50	30.29	1.37	5260.01	1.63	-	2.06	-
Gull Island SMR	709	0.02	0.02	-	14.59	27.36	0.46	1487.30	0.26	-	0.70	-
Gull Island SMR	710	0.04	0.12	-	17.56	13.40	0.93	6028.62	2.43	-	0.65	-
Harris Point SMR	689	0.05	0.10	-	19.19	5.89	0.35	14700.75	6.82	-	1.24	-
Harris Point SMR	690	1.49	0.35	-	38.19	3.11	0.13	27718.65	42.80	-	0.14	-
Judith Rock SMR	690	1.49	0.35	-	38.19	3.11	0.13	27718.65	42.80	-	0.14	-
Judith Rock SMR	713	1.37	0.03	-	1.37	0.42	0.03	91.59	0.14	-	0.06	-
Kashtayit SMCA	656	-	0.01	-	1.33	29.88	0.18	1112.73	0.26	-	0.97	-
Laguna Beach SMCA	737	0.02	0.01	-	24.25	-	0.72	36.38	0.65	-	0.24	-
Laguna Beach SMR	737	0.02	0.01	-	24.25	-	0.72	36.38	0.65	-	0.24	-
Long Point SMR	761	0.00	0.04	-	87.89	5.50	0.87	148.67	-	0.36	0.48	0.00
Lover's Cove SMCA	760	-	-	-	20.67	2.05	0.24	73.39	-	-	0.33	-
Matlahuayl SMR	842	0.03	0.03	0.00	19.90	0.23	0.07	39.29	0.05	-	0.27	-
Naples SMCA	654	0.01	0.00	-	2.42	30.65	0.13	760.38	1.86	0.08	0.96	-
Painted Cave SMCA	687	0.05	0.02	-	27.20	40.65	0.56	3009.64	6.11	0.01	0.89	-
Point Conception SMR	657	-	0.01	-	1.75	33.01	0.21	1426.47	0.50	0.01	1.60	-
Point Conception SMR	658	-	-	-	0.85	2.33	0.08	81.88	-	-	0.03	-
Point Dume SMCA	680	0.00	0.00	-	17.19	1.41	2.05	1663.76	0.85	0.01	0.68	-
Point Dume SMCA	681	0.00	0.00	-	6.65	0.65	0.48	2122.68	6.06	-	1.02	-
Point Dume SMCA	703	-	-	-	1.45	0.59	0.56	31.07	-	0.26	1.85	-
Point Dume SMCA	704	-	-	-	2.50	1.71	0.08	17.51	-	-	1.05	-
Point Dume SMR	680	0.00	0.00	-	17.19	1.41	2.05	1663.76	0.85	0.01	0.68	-
Point Dume SMR	703	-	-	-	1.45	0.59	0.56	31.07	-	0.26	1.85	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Amphistichus koelzi*	*Anarrhichthys ocellatus*	*Anisotremus davidsonii*	*Aplysia spp.*	*Cancer spp.*	*Caulolatilus princeps*	*Cebidichthys violaceus*	*Cephaloscyllium ventriosum*
Point Vicente SMCA	720	-	0.01	0.34	41.43	190.13	14.50	-	0.01
Richardson Rock SMR	690	-	-	0.10	-	137.77	15.91	0.01	-
Richardson Rock SMR	691	-	-	-	-	0.34	0.54	-	-
SWAT 1	829	-	-	0.01	-	3.11	10.78	-	-
SWAT 1	830	-	-	-	-	0.55	0.10	-	-
Wilson Cove	828	-	-	-	-	0.77	0.06	-	-
Wilson Cove	829	-	-	0.01	-	3.11	10.78	-	-
Wilson Cove	849	0.00	-	0.00	-	1.48	12.58	-	-
Wilson Cove	850	-	-	0.01	-	6.40	11.48	-	-
San Diego-Scripps Coastal SMCA	842	-	0.00	0.04	-	48.12	3.14	-	-
Santa Barbara Island SMR	764	-	-	0.01	-	-	0.52	-	-
Santa Barbara Island SMR	765	-	0.01	0.22	-	16.14	23.96	-	-
Scorpion SMR	685	-	-	0.01	-	21.69	30.63	-	-
Skunk Point SMR	710	-	-	0.00	-	197.50	8.77	-	-
South La Jolla SMCA	860	0.00	0.01	0.53	0.81	550.62	12.89	0.01	0.01
South La Jolla SMCA	861	-	0.00	0.00	-	8.35	7.16	-	-
South La Jolla SMR	860	0.00	0.01	0.53	0.81	550.62	12.89	0.01	0.01
South Point SMR	711	0.00	0.02	0.01	-	248.32	20.97	0.00	-
Swami's SMCA	821	-	-	0.02	-	36.36	0.22	-	-
Swami's SMCA	822	-	-	0.03	-	20.35	1.73	-	-
Swami's SMCA	842	-	0.00	0.04	-	48.12	3.14	-	-
Swami's SMCA	843	-	-	0.02	-	1.91	0.79	-	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Cheilotrema saturnum*	*Chromis punctipinnis*	*Citharichthys sordidus*	*Crassadoma gigantea*	*Embiotoca jacksoni*	*Girella nigricans*	*Gymnothorax mordax*	*Halichoeres semicinctus*
Point Vicente SMCA	720	0.03	0.22	0.02	0.01	0.56	2.80	0.08	0.01
Richardson Rock SMR	690	-	0.00	-	1.13	0.00	0.36	0.02	-
Richardson Rock SMR	691	-	0.00	-	-	-	-	-	-
SWAT 1	829	-	-	-	0.00	-	0.44	0.01	0.00
SWAT 1	830	-	-	-	-	-	-	-	-
Wilson Cove	828	-	-	-	-	-	0.00	0.01	-
Wilson Cove	829	-	-	-	0.00	-	0.44	0.01	0.00
Wilson Cove	849	-	1.66	-	0.01	-	0.27	0.10	0.00
Wilson Cove	850	-	0.01	-	0.00	-	0.18	1.16	-
San Diego-Scripps Coastal SMCA	842	0.00	0.00	-	0.00	-	0.00	0.43	0.00
Santa Barbara Island SMR	764	-	0.02	-	0.00	-	0.07	-	-
Santa Barbara Island SMR	765	0.01	0.00	-	0.12	0.02	0.88	0.02	-
Scorpion SMR	685	-	0.01	-	0.88	-	0.50	0.00	0.00
Skunk Point SMR	710	-	0.01	-	0.39	0.00	0.04	-	-
South La Jolla SMCA	860	2.14	0.00	0.04	0.04	1.21	2.21	9.07	0.00
South La Jolla SMCA	861	0.01	0.00	0.06	0.00	0.04	0.00	-	0.00
South La Jolla SMR	860	2.14	0.00	0.04	0.04	1.21	2.21	9.07	0.00
South Point SMR	711	-	0.00	-	0.35	0.03	0.11	0.01	0.00
Swami's SMCA	821	-	-	-	-	-	0.00	0.31	-
Swami's SMCA	822	0.03	0.00	-	-	-	0.00	0.01	-
Swami's SMCA	842	0.00	0.00	-	0.00	-	0.00	0.43	0.00
Swami's SMCA	843	0.00	0.00	-	-	-	-	0.01	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	**Block**	***Haliotis assimilis***	***Haliotis corrugata***	***Haliotis cracherodii***	***Haliotis fulgens***	***Haliotis kamtschatkana***	***Haliotis rufescens***	***Haliotis sorenseni***	***Haliotis walallensis***
Point Vicente SMCA	720	-	0.02	-	-	-	0.96	-	-
Richardson Rock SMR	690	0.00	15.37	592.66	2.58	0.02	798.10	0.01	0.00
Richardson Rock SMR	691	-	0.01	3.44	-	-	4.36	-	-
SWAT 1	829	-	4.82	6.02	4.81	-	0.01	0.27	-
SWAT 1	830	-	-	0.03	0.05	-	0.10	-	-
Wilson Cove	828	-	-	-	-	-	-	-	-
Wilson Cove	829	-	4.82	6.02	4.81	-	0.01	0.27	-
Wilson Cove	849	-	2.33	2.05	1.89	-	0.14	-	-
Wilson Cove	850	-	80.04	277.77	103.02	-	3.18	0.31	-
San Diego-Scripps Coastal SMCA	842	-	0.14	-	0.15	0.00	0.48	0.03	-
Santa Barbara Island SMR	764	-	-	-	-	-	-	-	-
Santa Barbara Island SMR	765	-	4.57	3.32	4.66	-	1.96	0.00	-
Scorpion SMR	685	-	9.33	0.03	0.11	-	13.38	0.00	-
Skunk Point SMR	710	0.00	4.69	3.90	0.08	-	12.15	0.00	-
South La Jolla SMCA	860	0.00	19.31	6.20	7.51	0.00	80.85	0.40	-
South La Jolla SMCA	861	-	0.26	0.02	0.13	0.00	5.89	-	0.00
South La Jolla SMR	860	0.00	19.31	6.20	7.51	0.00	80.85	0.40	-
South Point SMR	711	-	3.35	5.89	0.07	-	34.25	-	-
Swami's SMCA	821	-	0.32	0.02	0.18	-	0.18	-	-
Swami's SMCA	822	-	0.02	-	0.01	-	-	-	-
Swami's SMCA	842	-	0.14	-	0.15	0.00	0.48	0.03	-
Swami's SMCA	843	-	0.10	0.01	-	-	1.08	-	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Hermosilla azurea*	*Heterodontus francisci*	*Heterostichus rostratus*	*Hexagrammos decagrammus*	*Hypsurus caryi*	*Hypsypops rubicundus*	*Kelletia Kelleti*	*Lythrypnus dalli*
Point Vicente SMCA	720	-	0.01	0.00	-	0.00	0.01	22.67	-
Richardson Rock SMR	690	-	-	-	0.09	0.01	-	0.90	-
Richardson Rock SMR	691	-	-	-	-	-	-	-	-
SWAT 1	829	-	-	-	-	-	-	0.01	-
SWAT 1	830	-	-	-	-	-	-	-	-
Wilson Cove	828	-	-	-	-	-	-	0.60	-
Wilson Cove	829	-	-	-	-	-	-	0.01	-
Wilson Cove	849	-	-	-	0.00	-	-	0.44	-
Wilson Cove	850	-	0.00	-	-	-	0.02	0.16	-
San Diego-Scripps Coastal SMCA	842	-	-	-	-	-	-	1.77	-
Santa Barbara Island SMR	764	-	-	-	-	-	-	-	-
Santa Barbara Island SMR	765	0.02	-	-	0.00	0.00	-	0.44	-
Scorpion SMR	685	-	-	-	0.19	-	-	0.81	-
Skunk Point SMR	710	-	-	-	0.00	-	-	5.11	-
South La Jolla SMCA	860	0.29	6.88	0.00	0.00	-	0.00	74.60	-
South La Jolla SMCA	861	-	0.06	0.00	-	-	-	0.06	-
South La Jolla SMR	860	0.29	6.88	0.00	0.00	-	0.00	74.60	-
South Point SMR	711	-	-	-	0.08	0.00	-	7.36	-
Swami's SMCA	821	-	-	-	-	-	-	0.10	-
Swami's SMCA	822	-	-	0.00	-	-	-	0.86	-
Swami's SMCA	842	-	-	-	-	-	-	1.77	-
Swami's SMCA	843	-	-	-	-	-	-	-	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Medialuna californiensis*	*Megathura crenulata*	*Mycteroperca xenarcha*	*Myliobatis californica*	*Ophiodon elongatus*	*Oxyjulis californica*	*Panulirus interruptus*	*Paralabrax clathratus*
Point Vicente SMCA	720	10.06	0.11	-	0.05	7.60	0.01	237.66	389.18
Richardson Rock SMR	690	0.18	0.01	-	-	135.95	-	31.58	3.70
Richardson Rock SMR	691	-	-	-	-	15.77	-	0.01	0.36
SWAT 1	829	13.53	-	-	0.03	7.14	0.00	69.57	171.73
SWAT 1	830	0.18	-	-	-	0.20	-	1.82	0.81
Wilson Cove	828	0.02	-	-	-	0.02	-	0.17	1.00
Wilson Cove	829	13.53	-	-	0.03	7.14	0.00	69.57	171.73
Wilson Cove	849	18.20	-	-	0.03	2.25	-	46.30	371.51
Wilson Cove	850	7.20	-	-	-	3.09	-	314.88	163.59
San Diego-Scripps Coastal SMCA	842	0.06	-	-	-	2.73	-	134.43	45.76
Santa Barbara Island SMR	764	0.34	-	-	-	0.72	-	0.42	1.73
Santa Barbara Island SMR	765	3.12	-	-	0.02	17.39	-	131.43	41.36
Scorpion SMR	685	7.67	0.02	-	0.02	20.39	-	66.12	272.89
Skunk Point SMR	710	0.75	-	-	-	13.36	-	58.76	11.36
South La Jolla SMCA	860	1.67	0.01	0.07	1.25	42.56	0.00	1504.20	738.31
South La Jolla SMCA	861	0.30	-	-	0.28	23.57	-	4.36	343.35
South La Jolla SMR	860	1.67	0.01	0.07	1.25	42.56	0.00	1504.20	738.31
South Point SMR	711	0.24	-	-	0.35	46.64	-	123.74	12.75
Swami's SMCA	821	0.05	-	-	0.02	0.13	-	245.29	20.67
Swami's SMCA	822	0.17	-	-	0.02	0.82	-	29.10	71.86
Swami's SMCA	842	0.06	-	-	-	2.73	-	134.43	45.76
Swami's SMCA	843	0.10	-	-	0.03	1.36	-	0.94	24.64

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Paralabrax nebulifer*	*Parastichopus parvimensis*	*Phanerodon furcatus*	*Pleuronichthys coenosus*	*Rhacochilus toxotes*	*Rhacochilus vacca*	*Scorpaena guttata*	*Scorpaenichthys marmoratus*
Point Vicente SMCA	720	389.18	299.21	30.66	0.00	0.00	0.16	0.01	106.31
Richardson Rock SMR	690	3.70	0.28	16.39	0.00	-	0.11	-	2.29
Richardson Rock SMR	691	0.36	0.01	-	-	-	-	-	0.03
SWAT 1	829	171.73	0.65	33.40	-	-	0.00	-	10.82
SWAT 1	830	0.81	0.13	-	-	-	-	-	0.48
Wilson Cove	828	1.00	1.39	-	-	-	0.00	-	0.20
Wilson Cove	829	171.73	0.65	33.40	-	-	0.00	-	10.82
Wilson Cove	849	371.51	2.33	41.53	-	-	-	-	8.09
Wilson Cove	850	163.59	1.09	73.33	-	-	0.02	-	8.09
San Diego-Scripps Coastal SMCA	842	45.76	30.77	-	0.00	-	0.00	-	7.29
Santa Barbara Island SMR	764	1.73	0.33	0.27	-	-	0.00	-	0.42
Santa Barbara Island SMR	765	41.36	0.98	70.06	0.00	-	0.03	-	12.30
Scorpion SMR	685	272.89	11.80	52.16	0.00	-	0.03	-	14.13
Skunk Point SMR	710	11.36	2.92	7.90	-	-	0.01	-	0.81
South La Jolla SMCA	860	738.31	181.18	15.57	0.00	-	0.05	0.00	102.48
South La Jolla SMCA	861	343.35	129.13	0.93	-	-	0.01	-	34.95
South La Jolla SMR	860	738.31	181.18	15.57	0.00	-	0.05	0.00	102.48
South Point SMR	711	12.75	0.56	28.69	-	-	0.03	-	10.91
Swami's SMCA	821	20.67	10.78	-	-	-	0.00	-	2.13
Swami's SMCA	822	71.86	92.18	-	-	-	0.00	-	12.56
Swami's SMCA	842	45.76	30.77	-	0.00	-	0.00	-	7.29
Swami's SMCA	843	24.64	14.09	0.91	-	-	0.00	-	1.66

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Sebastes atrovirens*	*Sebastes auriculatus*	*Sebastes carnatus*	*Sebastes caurinus*	*Sebastes chrysomelas*	*Sebastes dallii*	*Sebastes hopkinsi*	*Sebastes mystinus*	*Sebastes rastrelliger*
Point Vicente SMCA	720	0.01	0.25	0.03	1.26	-	-	-	0.24	0.02
Richardson Rock SMR	690	0.24	0.29	5.20	6.70	0.11	-	-	2.36	24.05
Richardson Rock SMR	691	-	-	0.09	0.25	-	-	-	0.09	0.13
SWAT 1	829	0.00	-	0.03	0.15	-	-	-	0.04	0.01
SWAT 1	830	-	-	0.00	0.00	-	-	-	-	-
Wilson Cove	828	-	-	-	-	-	-	-	-	-
Wilson Cove	829	0.00	-	0.03	0.15	-	-	-	0.04	0.01
Wilson Cove	849	0.00	-	0.03	0.09	0.00	-	-	0.03	0.00
Wilson Cove	850	-	-	0.03	0.12	-	-	-	0.03	0.01
San Diego-Scripps Coastal SMCA	842	0.00	0.04	0.03	0.02	-	0.00	0.00	0.04	0.03
Santa Barbara Island SMR	764	-	-	-	-	-	-	-	-	-
Santa Barbara Island SMR	765	-	-	0.75	0.61	-	-	-	0.44	0.00
Scorpion SMR	685	0.02	0.03	1.71	4.74	0.02	-	-	1.09	1.48
Skunk Point SMR	710	0.08	0.22	2.88	5.63	0.01	-	-	0.97	1.77
South La Jolla SMCA	860	0.03	0.33	1.25	0.69	0.01	0.00	0.02	0.55	0.29
South La Jolla SMCA	861	-	0.20	0.16	0.14	-	-	-	0.01	0.00
South La Jolla SMR	860	0.03	0.33	1.25	0.69	0.01	0.00	0.02	0.55	0.29
South Point SMR	711	0.78	0.23	13.28	18.66	0.09	-	-	5.71	29.62
Swami's SMCA	821	0.01	0.00	0.01	0.01	-	-	-	-	0.00
Swami's SMCA	822	-	0.01	0.03	0.05	-	-	-	0.00	0.00
Swami's SMCA	842	0.00	0.04	0.03	0.02	-	0.00	0.00	0.04	0.03
Swami's SMCA	843	-	-	0.00	0.01	-	-	-	0.00	-

Table H.2 (continued). Total harvest (metric tons) from 1980-2009 by species in each fishing block that overlaps with an MPA in the SCSR. Includes both the commercial and recreational (CPFV) landings. Fishing block data was extracted from the Pacific Coast Fisheries GIS Resource Database (Perry et al. 2010; Original data source: State of California, The Resources Agency, Department of Fish and Wildlife, USA). Note that "-" indicates an actual zero harvest value.

MPA	Block	*Sebastes serranoides*	*Sebastes serriceps*	*Sebastes umbrosus*	*Semicossyphus pulcher*	*Squatina californica*	*Stereolepis gigas*	*Strongylocentrotus franciscanus*	*Strongylocentrotus purpuratus*	*Torpedo californica*	*Triakis semifasciata*	*Xenistius californiensis*
Point Vicente SMCA	720	1.03	0.00	-	30.65	0.33	2.78	2054.85	46.17	0.53	7.63	-
Richardson Rock SMR	690	1.49	0.35	-	38.19	3.11	0.13	27718.65	42.80	-	0.14	-
Richardson Rock SMR	691	-	0.00	-	0.17	0.08	-	31.15	-	-	-	-
SWAT 1	829	0.04	0.01	-	74.70	0.89	3.74	3212.39	0.14	-	0.77	-
SWAT 1	830	-	-	-	0.70	-	-	26.47	-	-	-	-
Wilson Cove	828	-	-	-	0.49	-	0.14	1.95	-	-	-	-
Wilson Cove	829	0.04	0.01	-	74.70	0.89	3.74	3212.39	0.14	-	0.77	-
Wilson Cove	849	0.00	0.01	0.00	73.93	0.28	0.55	93.52	-	-	0.49	-
Wilson Cove	850	-	0.06	-	122.54	1.74	1.01	10709.31	12.69	-	1.03	-
San Diego-Scripps Coastal SMCA	842	0.03	0.03	0.00	19.90	0.23	0.07	39.29	0.05	-	0.27	-
Santa Barbara Island SMR	764	-	-	-	1.28	0.09	0.34	14.59	-	-	0.30	-
Santa Barbara Island SMR	765	0.08	0.01	-	71.63	0.67	2.04	1949.06	3.50	0.02	1.30	-
Scorpion SMR	685	0.02	0.01	-	56.68	22.42	1.26	476.56	0.75	-	2.98	-
Skunk Point SMR	710	0.04	0.12	-	17.56	13.40	0.93	6028.62	2.43	-	0.65	-
South La Jolla SMCA	860	0.22	0.37	0.00	185.46	6.49	3.74	12490.35	12.34	0.00	13.32	0.00
South La Jolla SMCA	861	-	0.00	-	11.33	0.08	0.42	19.58	-	-	0.78	0.00
South La Jolla SMR	860	0.22	0.37	0.00	185.46	6.49	3.74	12490.35	12.34	0.00	13.32	0.00
South Point SMR	711	0.29	0.54	-	136.69	40.09	1.14	11296.45	18.03	-	1.05	-
Swami's SMCA	821	-	0.01	-	11.66	0.60	0.20	45.66	0.10	-	0.75	-
Swami's SMCA	822	0.00	0.00	-	4.88	0.14	0.35	5.08	0.04	-	0.45	-
Swami's SMCA	842	0.03	0.03	0.00	19.90	0.23	0.07	39.29	0.05	-	0.27	-
Swami's SMCA	843	-	0.00	-	2.12	-	-	36.94	-	-	0.02	-